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No. 28—*July* 1840.

I.—*Catalogue of the Birds of the Peninsula of India, arranged according to the modern system of Classification; with brief Notes on their Habits and Geographical Distribution, and description of new, doubtful and imperfectly described Species.—By* T. C. Jerdon, *Assistant Surgeon, 2d Madras Light Cavalry.*

(*Continued from No.* 27, *page* 239.)

Ord. III.—RASORES, Ill. Swains.—*Game Birds* and *Pigeons.*

Family PAVONIDÆ.

Genus PAVO, L.—*Peacock.*

265.—*P. cristatus*, L.—*Mohr*, H. and Mah.—*Common Peafowl.*

The *Peafowl* abounds in most of the wooded districts of India, and also in woody nullahs, and low jungle in various parts of the country. It breeds most usually towards the end of the monsoon.

GENUS GALLUS, Briss.

266.—*G. Sonneratii*, Temm.—*Junglee Moorgh*, H.—*Common Jungle Fowl.*

This *Jungle Fowl* is tolerably abundant in most of the lofty jungles of the South of India, and is also found in the lower jungle in the Carnatic and eastern range of ghauts. It is not, however, met with in the Northern Circars. It is very partial to bamboo jungle. I once found the eggs of this fowl, seven in number, on the ground in dense jungle at the foot of the Neilgherries. They were of a light pinkish cream colour.

267.—*G. Bankiva*, Temm.—*Red Jungle Fowl.*

This species, hardly distinguishable in appearance from many of the domestic varieties, and unquestionably the origin of most of the varieties of our common fowls, is the only jungle fowl found in the woods of the eastern ghauts in the Northern Division, and is very abundant in some parts, as in Goomsoor. I do not know exactly how far south this species extends, but know that it is found as low as Cummum, N. L. 16°. The crow of this bird is much more distinct and marked than that of the last one, which has only a broken and very indistinct call.

FAMILY TETRAONIDÆ.

GENUS ORTYGIS, Ill. Swains.—*Hemipodius*, Temm.—*Three-toed Quail.*

268.—*O. pugnax.*—*Hemip. pugnax.*, Temm. P. C. 60-2.—*Tetrao nigricollis* and *Madagascariensis* of the older authors?—*Gooloo*, H. in the South of India.—*Toorah* of others.—*Black throated three-toed Quail.*

This pretty species is tolerably common in most of the well cultivated parts of India, frequenting low jungle, and also fields of pulse, chillee, &c. It is sometimes found solitary, often in pairs, but also in bevies of 5, 6 or 7. It feeds on various grains and seeds, also much upon insects, especially white ants, and the larvæ of grasshoppers, &c.

Colonel Sykes and M. Temminck assert the identity of the plumage of both sexes, and though I did not examine them when I shot several in company, they were always clothed alike.

This bird is often caught and caged by the Mussulmauns of Southern India. It has a peculiarly loud purring call, and this is made use of to ensnare others in the following manner. The female is taken into the jungle in a small cage, chiefly during the breeding season, which is said to be (in the Carnatic) about the end of the monsoon. The cage has a small plank in front of the bars, over which an arched cover is made to fall by the snapping of some thread, placed between the bars. It is then placed on the ground in a low bush and partially concealed by leaves, &c. The bird within begins its loud purring, and any of its kind in the neighbourhood run rapidly to the spot, and commence pecking at the bars of the cage—this soon breaks the thread, and the spring cover falls, ringing a small bell at the same time, by which the owner, who remains concealed, is warned of a capture—15 or 20 are occasionally caught in this way in a single day.

Irides light yellow; bill and legs dull bluish. Length $6\frac{1}{2}$ inches; wing nearly $3\frac{1}{2}$; tarsus $\frac{8}{10}$ths; bill to front $\frac{1}{2}$ inch; weight about 2 oz. 1 dr.

268, *Bis.—O. Taigoor*, Sykes; figured Trans. Zool. Soc. vol. 2.

From the few opportunities I have had of observing this bird, I am inclined to agree with Colonel Sykes, and place it as a distinct species. I have only procured it solitary, in long grass on the more open spaces of the forests of the Western Coast. Bill bluish, with a tinge of yellow beneath. Irides pale yellow. Length 6 to $6\frac{1}{4}$ inches; wing 3; tarsus fully $\frac{8}{10}$ths; bill rather shorter and less high than in the preceding species.

269.—*O. Dussumierii.—Hemip. Dussumierii*, Temm. P. C.—*Toorah*, H.—*Smallest three-toed Quail.—Button Quail* of some Europeans.

This very small bird, probably one of the least of the order, is always found solitary, generally in long grass, sometimes in the fields of pulse. It is flushed with difficulty, and, as Colonel Sykes remarks, its flight is abrupt and short. Irides pale yellow; bill dusky; legs whitish flesh-coloured. Length $5\frac{1}{2}$ inches; wing nearly 3; tarsus $\frac{7}{10}$ths; bill front $\frac{4}{10}$ths.

Gen. TETRAO.

Sub-gen. PTEROCLES, Temm.—*Rock*, or *Whistling Grouse*.

270.—*P. exustus*, Temm. P. C.—354 and 360.—*Bur-Teetur*, H.—*Common Whistling Grouse.—Rock Pigeon* of Europeans.

This is a very common and abundant bird in most parts of the open country. It is not found in wooded districts. It associates in parties

varying in number from 4 or 5 to 50, or even more, and frequents the open stony plains, and bare fields. It flies swiftly, and generally at a considerable height, and as Colonel Sykes has remarked " has a most peculiar and piercing cry which often announces its approach ere it is observed." It feeds chiefly on a very hard kind of seed. When approached it often squats close, and it is very difficult to distinguish it in some pieces of ground. After its morning meal it always goes to some neighbouring water to drink. Its flesh, which is brown and white, is remarkably hard and tough, and will keep longer than that of any other game bird; this hardness causes it to be less appreciated than it deserves to be, for, when kept a sufficient time and well dressed, it has an excellent flavour, inferior to very few of the Indian game birds.

I have found its eggs several times lately in the months of January and February, placed on the ground without any nest, 3 in number and of light olive greenish hue, speckled with olive brown and dusky, of a very long shape, and equally rounded at both ends.

Length about 13 or 14 inches; wing 7; tail (centre feather) 5; weight of male about 9 oz.; bill, legs, and naked skin round eye, cinereous.

271.—*P. quadricinctus*, Temm.—*Tetrao Indicus* of Gmelin.—*Hundeyree*, H.—*Painted Whistling Grouse* or *Rock pigeon.*

This richly plumaged *rock grouse*, is much more rare than the last, and unlike it is neither gregarious nor found in the open plains. It lives in pairs, and frequents bushy plains, and stony and jungly hills. It flies but a short distance, and its cry, which is of the same character as that of its congener, though much less loud, and deeper, is never heard except when the birds are first flushed.

I have lately got the eggs of this species, also, very similar to the other, bu rather smaller, and with the spots fewer and larger.

Irides deep brown; bill red; naked skin round eye, lemon yellow with a green tinge; feet ochre yellow; claws reddish. Length 10 inches; wing $7\frac{1}{4}$; tail 3; weight of cock bird about 7 oz.

Gen. PERDIX.—*Partridge.*

272.—*P. picta*, Jard. and Selby, Ill. Ornith.—*P. Hepburnii*, Gray and Hardw., Ill. Ind. Zool.—*Kala Teetur*, H.—*Painted Partridge.*

The painted *Partridge* is not found in the Carnatic, nor in the Malabar Coast, and I believe not in the more southern portion of the table land. It begins to be met with first in any quantity about N. lat. 15°, in the neighbourhood of Bellary, and becomes more numerous as you advance towards the north. It frequents both low bushy jungle

and grain-fields, especially those of wheat, and also long grass by the sides of rivers, water-courses and elsewhere. The cock bird has a most peculiar crowing note, which though not very loud, is yet heard a long way off. It may be heard morning and evening uttering this croak, generally seen to do so whilst perched on a bush. Mr. Elliot says well on this subject—"Its peculiar cry may be expressed by the syllables *Chē-kĕ-kĕrrēy*, pronounced very gutturally. The poults chirrup like crickets" The *painted Partridge* is not found in coveys, generally single or in pairs. It breeds during the monsoon, lays 6 or 7 eggs of a smoky bluish white colour, of an oval form, much depressed at the thick end. It is not held in very high esteem for the table. Bill blackish; irides brown; legs yellowish red. Length about 12 inches; tarsus $1\frac{7}{10}$ths; weight of male about 11 oz.

Sub Genus FRANCOLINUS.—*Spurred Partridges.*

273.—*F. Ponticerianus,—Perd. Orientalis*, Gray and Hardw., Ill. Ind. Zool.—*Teetur*, H.—*Common Partridge* of India—*Scavenger Partridge* of some.

The common *Partridge* is found in every part of the peninsula, both in bushy ground, and more especially in cultivated lands, fields and gardens, delighting in the hedge rows. It perches freely even during the day. The cock bird has a most peculiarly loud and piercing call. It is often caught and tamed by the natives, and becomes most familiar, following its owner like a dog and uttering its loud call, when whistled or spoken to. It is also much used for fighting, which it does with great courage and spirit. Its flesh is held in no esteem by Europeans. It breeds towards the end of the monsoon, and in the cold weather. An opinion prevails among the natives, that the partridge lives for seyen years, and is then changed into a Cobra di capella!

274.—*F. Spadiceus.—Perd. Spadiceus*, Lath.—*Spur-fowl* of Europeans in India.

Unlike the last species, the *spur-fowl* is only found in the denser jungles, as well as of the Eastern as of the Western Coast, and generally along with the *Jungle fowl*. It is found in the low brushwood of the lofty forests, and when flushed, as it is with difficulty, frequently perches on the bough of some lofty tree. It is generally found in pairs, and feeds on various seeds and insects. I found the craws of some crammed with insects alone, among which various species of *Cimices* were the most predominant. Its flesh is excellent and of very high flavour. It is found on the top of the Neilgherries in the dense woods there. The

female has been well described by Colonel Sykes. The natives generally consider this bird as more allied to the *jungle fowls* than to the partridges, and it is said to run with its tail elevated.

Bill, naked skin round eye, and legs red. Length 14-15 inches; of which the tail is about 5.

Sub-Genus COTURNIX, Briss.—*Quails.*

275.—*C. Dactylisonans.*—*Ghaghus*, H.—*Large grey Quail* or *Deccany Quail.*

The quail of Europe is by no means common in most parts of the peninsula, and certainly appears in greatest abundance during the cold weather, though according to Sykes and others, it remains and breeds here during the monsoon. It is found generally in long grass by the sides of rivers, tanks, and nullahs, or among the grain-fields, and generally in pairs.

Length 7½ to 8 inches. Average weight about 4½ oz.; bill dusky brown; irides light brown; legs flesh-coloured.

276.—*C. Textilis*, Temm.—*Perd. Coromandelica*, Lath.—*P. olivacea*, Buch.—*Batteir*, H.—*Black breasted Quail.*—*Rain quail* of some.

This pretty little species is very common in most of the well cultivated districts of India, frequenting the fields in bevies, and also patches of grass in various situations, and low jungle. It breeds during the monsoon; many natives consider it as the male of the last. Irides reddish brown; bill horny brown.

Length 6—6½ inches; weight about 2½ oz.

277.—*C. argoondah*, Sykes.—*Perd. Cambayensis*, Auct. ?—*Lewah*, H. —*Rock Quail*—*Bush Quail* of some.

The common rock quail is exceedingly abundant in every part of India, frequenting bushy and stony ground, and also the neighbouring grain-fields in considerable bevies. It is much used by the natives for fighting, which it does with great spirit and obstinacy.

Irides reddish brown; bill dusky blackish; legs red. Length 6—6½ inches.

278. *C. pentah*, Sykes—*Perd. rubiginosa*, Valenc.—*Geerzah*, H.—*Forest quail.*

I fully agree with Col. Sykes in separating this species from the last, from my own observations, its different habitat, and the testimony of all the quail fanciers of Southern India, who will at once point out a

Geerzah among a lot of '*Lowahs*'. It is an inhabitant of all the forests of S. India, and also occasionally and more sparingly found in low jungles, and wooded nullahs in the Carnatic and other regions. It is found at all levels, from the neighbourhood of the sea to the summits of the lofty mountains of the Western Ghauts. The *Geerzah*, though also caught and used for fighting, is in less esteem than the *Lowah*. Irides brown; bill dusky; legs reddish yellow. Length $6\frac{1}{2}$—$6\frac{3}{4}$ inches.

279.—*C. erythrorhyncha*, Sykes.—*Koknee Lowah*, H.—*Red-billed Quail.—Black quail* of the Neilgherries.

This very handsomely plumaged quail is very abundant on the top of the Neilgherries, frequenting the low brushwood of the woods, and occasionally entering gardens. As it is mentioned by Colonel Sykes and also by Mr. Elliot, in his Catalogue, it is probably to be found in all the more elevated districts of the Western Ghauts.

Bill and legs fine red; irides brown. Length $6\frac{1}{2}$; weight about $2\frac{3}{4}$ oz.

280.—*C. Chinensis.—Perd. Chinensis*, Auct.

There is an accurate description of this species of quail in Mr. Elliot's notes, taken from a single specimen, shot by a gentleman near Belgaum in the Southern Mahratta Country.

Fam. TRUTHIONIDÆ.

Gen. OTIS, L.

281.—*O. nigriceps*, Vigors—Gould Cent. Him. Birds.—*O. Edwardsii*, Gray and Hardw., Ill. Ind. Zool.—*Tokdar*, H.—*Black-headed* or *Indian Bustard.*

This noble bird is found, I believe, over all the peninsula, except perhaps on the wooded regions of the Western Coast, but more numerous in some localities than in others. Wherever there are extensive plains, whether of long grass or cultivated, this bird is most abundant, more especially on the trap formation of the north-west part of the great table land. The *Bustard* is frequently seen alone, occasionally 2, 3 or 4 together, and often flocks of 20 or more are seen feeding in company. Its most favourite food is large locusts and grasshoppers, also the common black and red *mylabris*, various insects of the genus *buprestis*, *scarabæus* and others, caterpillars, centipedes, and even lizards. Mr. Elliot mentions a quail's egg entire having been found in the stomach of one. In

default of insect food, it eats various fruit, grains and seeds, especially the fruit of the *Ber* (*Zizyphus Jujuba*). Several small stones are generally found in the stomach, and I once found some large fragments of a brass bangle in one.

The *Bustard* breeds most generally about the end of the monsoon, and subsequent cold weather, the female laying one or two eggs; it, however, varies much in the time of breeding. The egg is of a dark olive colour, with obscure darker blotches. When feeding, it is generally wary and difficult to approach, but during the heat of the day it lies down either in the long grass, or in the shade of some bush, and is then often approached quite close. It usually takes a long flight when once raised, often several miles, and flies with a continued flapping of its wings, never sailing.

The *Bustard* has a loud hoarse call, by some compared to a bark or a bellow, this is rarely heard however, except when the bird is alarmed. It has, however, another cry, as I learn from Mr. Elliot's notes, which is probably the call to its mate. I extract Mr. Elliot's note on the subject. "October 12th, killed a large *cock bustard*. When first seen he was making a curious noise, like a person in pain moaning, which was heard at a considerable distance. I at first thought it proceeded from some one in distress, and rode towards the spot under that impression, until I saw the *bustard*. He was strutting about on some high ground, expanding his tail, ruffling his wings, and distending his neck and throat, making the feathers stand out like a ruff. I frequently afterwards heard the moaning, always at the same season."

The gular pouch of the cock bird can contain three quarts of water and more.

Length of male 4½ feet; wing 30 inch; tail 13; tarsus 8½; bill (front) 3; expansion of wings nearly 8 feet; weighs sometimes 25 or 26-lbs. The female is about a third less and measures about 3½ feet in length.

282.—*O. aurita*, Lath., Jard. and Selby, Ill. Orn.—*O. fulva*, Sykes.—probably also *O. Indica*, Auct.—*Churz*, H.—*Tun-mor*, Mahr.—*Kun-nowl*, Can.—*Florikin* and *Black Florikin*.

It is still a disputed point among naturalists and sportsmen whether the *black florikin* be a distinct species from the common one, or not—and the only two writers on Indian Ornithology who have observed the bird in its native haunts, viz. Major Franklin, and Colonel Sykes, have pronounced it to be a distinct species. From the synonymes I have adopted, it will be seen that I consider them identical, and from my own observations I have concluded that the *black florikin* is the cock bird, in its summer or breeding plumage *only*, Colonel Sykes having

accurately described its winter dress as being almost identical with that of the female. I may here state that there are two other opinions prevalent in India on this subject. One is that the *black florikin* is the young bird, and that he *changes* to the livery of the female; the other is that he is the adult cock bird, but that he does not change his plumage. The following are the chief reasons I have for considering the *black florikin* as the nuptial plumage of the common or *fulvous florikin.*

1st. All *black florikin* examined by me (and others, I believe,) have been males.

2d. The *black florikin agrees exactly* with the characters of the *male* of the *O. fulva*, as described by Sykes, in size, length of wing, and acumination of the quill feathers—the points of difference from the female.

3d. The time of the first appearance of the black plumage of the *florikin* corresponds with the era preceding the breeding season—and its disappearance also coincides with the termination of the breeding season; and I have seen specimens in all states of progressive change, from the female garb to that of the perfect *black florikin*, and again from this, their nuptial plumage, to the more sober livery of the rest of the year.

4th. No males in the grey or fulvous plumage, in which at least some black feathers were not visible, were ever shot by me during the breeding or summer season, i. e. from June to November.

5th. I may cite the evidence of Lieutenant Foljambes, in a brief paper in the Journal of the Asiatic Society of Bengal, in which he states it as his belief 'that they are the same bird, but that the black one is only met with in Guzrat during the monsoon,' i. e. the breeding season.

Lastly—I may state that several successful sportsmen, to whom I have lately mentioned my opinion on this subject, fully agreed with me, and even the opinion of those who considered the black birds to be young ones, is, I think, to be added to the testimony in favour of the black being the breeding plumage of the male bird.

In the neighbourhood of Jaulnah, where my observations have been chiefly made, I have seen the male bird just commencing to assume the black plumage early in May, and I believe the majority of them have assumed the perfect black plumage by the beginning of August. By the middle of November most of them have, with the exception of a few stray feathers, occasionally re-assumed their more sober grey livery. I am perfectly aware that there are many occasional exceptions to this; dependent, however, I am convinced, chiefly on the well known great irregularity of the time of breeding, so common in hot countries, where the birds are not compelled, as they are in a cold country, to limit

their season of breeding to an odd month or two : and also partly on the fact hereafter mentioned of many pairs breeding, especially towards the south of the peninsula, after the great annual immigration in October and November.

The most general time of breeding of the *florikin* about Jaulnah, is the months of August and September. Birds have, however, been flushed from their eggs as late as October. During this season the females are remarkably shy and wary, and flushed with difficulty, and during the whole monsoon, cock birds, either in a state of change, or in the perfect black plumage, are almost the only ones to be met with. I am informed by native sportsmen that the black bird is occasionally seen in company with the hen at this time, or walking round her whilst sitting on her eggs, yet I think it probable that the cock birds withdraw from the society of the hens soon after incubation has commenced.

Though a few couple remain in most parts of the country, for the whole year, and breed, yet the great body of them undoubtedly migrate to the peninsula at the beginning of the cold weather in October, and remain till March or April, when they emigrate for the purpose of breeding. As before mentioned, after their arrival, several couples undoubtedly breed, sometimes as late as December and January, especially in the Carnatic, the Northern Circars, and Mysore. I believe, however, that the great majority of them do not breed after their arrival in the south, and that such as do are probably the ones bred late in the south of the peninsula the previous year, and which were not sufficiently matured to do so along with the others, in the early monsoon season of Upper India. In the Carnatic, as about Trichinopoly, at the commencement of the season in October, a considerable number of those brought in by the native shikarees are black, chiefly, however, in a state of change from the perfect plumage—they leave this district in February.

I am informed that in the Nellore and Guntoor districts, both the most celebrated *florikin* grounds in Southern India, the *florikin* do not arrive in any numbers till November, and black birds are hardly ever met with. This, I may remark, is an additional proof in favour of my opinion. A few couple, most probably, remain even here, in the wilder and more sequestered parts, for I have heard of a *black florikin* being killed in the Tinnevelly district in the month of August. In the Southern Mahratta Country, as I learn from Mr. Elliot's notes, the *florikin* arrive towards the end of September, and remain till April, except a few stray birds in a *state of change* that remain through the *monsoon.*

The *florikin* frequents long grass in preference to any other situation. It is sometimes met with in the grain-fields, also in fields of cotton and

dholl, and in the Carnatic so much in those of the grain called *wanagon*, as to be named the "*Wanagon Bird.*"

It feeds chiefly in the morning, and is then easily raised, but during the heat of the day it lies very close, and is flushed with difficulty. It seldom flies far, but often runs a long way to escape being raised, especially on open ground. The chief food of the *florikin* is grasshoppers. I have also found blister beetles (*Mylabris*), scarabæi and other insects, and even occasionally centipedes and small lizards. I have sometimes, though rarely, heard it utter a kind of sharp *quirk* as it rose from the ground. It has also a kind of feeble plaintive chirp, or piping note when running. Its flesh is delicate, and of excellent flavour, and it is the most esteemed of the Indian game birds; and its pursuit is a favourite sport. From the open nature of the ground it frequents, it is well adapted for being hawked, and both the *Luggur* and *Shaheen* are often flown at it.

The egg is of a stunted thick ovoid form, very obtuse at the larger end, and of a dark olive colour.

Length of the male 18-19 inches; of wing 8; tail 4; tarsus hardly 4; bill front $1\frac{3}{10}$ths; weight 16-18 oz.

Length of female $19\frac{1}{2}$ to 21 inches; of one $20\frac{1}{2}$; wing $9\frac{3}{4}$; tail nearly 5; tarsus $4\frac{1}{2}$; bill front $1\frac{1}{2}$; weight 20 to 24 oz.; bill dusky above, edges of upper, and all lower mandible, whitish. Irides pale yellowish; legs dirty whitish yellow.

Family COLUMBIDÆ.—*Pigeons and Doves.*

Genus PTILINOPUS, Swains.

283.—*P. Elphinstonii*, Sykes.—*Imperial Pigeon* of the Neilgherries.

I have hitherto only found this fine pigeon in the dense woods on the summit of the Neilgherries, in small parties, or single. It is a retired and wary bird. I found various fruits and small shells in its stomach. Irides ochre yellow. Length about 15 inches.

Genus CARPOPHAGA, Selby.

284.—*C. ænea.*—*Col. ænea*, Auct.—*Pogonnah*, Mal.—*Imperial Green Pigeon.*

The *imperial pigeon* of Europeans on the West Coast is found in all the lofty forests of the West Coast, single or in small parties of 3 or 4. It feeds on various kinds of fruit, and has a single low plaintive note.

Irides and orbits, lake red; bill slaty, at base above red, at tip bluish white; legs lake red. Length 16 to 18 inches. I have never seen this bird with the knob on its bill as represented in books, nor have I heard of its ever being present.

285.—*C. cuprea.*—New species ?.—*Copper winged Imperial Pigeon.*

I possess a single specimen of a fine pigeon shot in the Wynaad by Captain Pope, of the Bombay army, to which, if it be a new species, the above name may be applied. It might be considered as the young of the last, but its large size, and the testimony of other sportsmen of a *copper winged pigeon* found in Coorg, lead me to suppose it distinct. I add a brief description. Head, neck, and beneath pale lilac grey or dun colour; chin white; back and wings brownish, with a faint coppery gloss; rump dark glossy cinereous; quills and tail dusky black, the latter tipped with cinereous; under tail coverts, yellowish white. Irides, orbits and feet red; bill red at base, cinereous at tip. Length 18 inches; wing $9\frac{1}{4}$; tail $6\frac{3}{4}$.

Genus VINAGO, Cuvier.—*Green Pigeons.*

286.—*V. militaris ?.*—*Hurriala*, vulgo *Hurwa*, H.—*Common Green Pigeon.*

This, the largest of its genus found in the peninsula, is at the same time by far the most common and universally spread, frequenting not only jungles, but groves, gardens, and especially the fine avenues of old banian, and other trees that line many of the roads in the southern part of the peninsula. It associates in large flocks, feeding much on the fig of the banian, and various other fruit trees. When seated quietly they are very difficult to distinguish among the green leaves.

Many are often brought down at a single discharge even when only 1 or 2 were visible. The *green pigeon* has a high flavour, and is considered excellent eating. As there is some doubt about the descriptions of this bird, which is represented as having *red* legs, and as Gould has figured as one of the sexes of this, a totally distinct species not found in the peninsula, I here add a brief description.

Head and neck, blue grey; back of neck, yellowish olive, bordered by a narrow band of blue grey; chin and throat grey, tinged with green; back and wings olive green; shoulders bluish purple; breast and abdomen yellowish green, mixed with bright yellow towards the lower abdomen and vent; under tail coverts reddish cinnamon colour, edged with yellowish

white; feathers of tarsus bright yellow; thigh coverts green, edged with whitish; tail entirely gray above; beneath blackish, with a broad margin of bluish white; feet saffron yellow; irides fine smalt blue, with an exterior circle of carmine; bill thick and strong, greenish white at base, bluish at the tip. Length 12 inches; wing 7½; tail 4.

In the young birds the under tail coverts are dusky green, edged with whitish, and this is the only material difference I have observed among numerous specimens from all parts of the country.

287.—*V. aromatica*, Auct.—*Marroon-backed green pigeon.*

I have only found this handsome green pigeon in small parties, in thick forest jungle in Malabar, and at the foot of the Neilgherries. One specimen differs somewhat from the others in having the face, forehead and chin yellow, the under tail coverts mottled with green and white, and in the bluish white tip of the lateral tail feathers being broader. This, I think, may be a young bird.

Bill and irides as in last: the former much more slender; feet and legs lake red. Length about 10½ inches; wing nearly 6; tail 4.

288.—*V. affinis.*—New species?—Young of last?

Descr.—Forehead and head grey; rest of plumage green; yellowish on chin; tail with centre feather green; exterior cinerous, with a black band near tip; under tail coverts barred with white and green; bill, irides, and feet as in the last; bill stronger. Length about 10½; tail 3½. This may be considered as the young of the last, which it resembles in size and form, but the absence of the rich marroon colour of back and wings, the fact of its being always found separate, and other circumstances, have induced me for the present to consider it as distinct. I have seen specimens of this pigeon in several collections made on the West Coast, but have only obtained it twice myself in forest jungle, and both times solitary.

289.—*V. bicincta.*—New species?—*V. purpurea*, Auct., Brown Ill. Zool.?—*V. vernans*, var., Less. Traité.—*Purple* and *orange breasted green pigeon.*

Descr.—Back of head and neck above blue grey; forehead, top of head, face, chin, throat, belly and rest of the plumage above, green of different shades; a broad band of orange or bright cinnamon yellow, on the breast, separated from the green of the throat by a light purple band; lower belly and vent yellow; some of the feathers streaked with green; under tail coverts entirely cinnamon colour: tail above grey, with a central dark band, and edged lighter; beneath almost black; whitish at the tip; edges of the

wing cover ts marked with yellow more broadly than in the other of this genus. Length about 10 inches ; wing 6 ; tail rather more than 4 ; feet red ; bill and irides as in others of the genus.

I have only seen this very prettily plumaged *green pigeon* in a tract of jungle near the sea coast, south of Tellicherry.

289, bis. V. *unicolor*.—New species ?—Young of last ?

Descr.—Above entirely olive green, except a shade of blue grey on the back of the neck ; beneath and forehead yellow green, almost yellow at the vent ; under tail coverts white, mixed with yellow and cinnamon ; tail and wings as in the last. Length the same ; wings and tail rather shorter.

I shot a single specimen of this pigeon in a grove of trees at Bimlipatam, in the Northern Circars, and have never again seen it. It is of the same slender make as the last species, and may be a young bird, but its very different locality has led me to place it separately for the present.

Gen. COLUMBA.

290.—*C. œnas*, L.—*Kabootur*, H.—*Blue pigeons.*

The blue pigeon abounds over all India, occasionally found in the more open spaces of jungles, especially in rocky districts, and in the neighbourhood of waterfalls—but more generally in the open country, inhabiting walls of villages, pagodas, wells, and any large buildings, and breeding chiefly in old walls.

Irides orange ; legs red.

291.—*C. Javanica.—Bronze-winged Dove.—Imperial Dove* of some.

This very lovely pigeon somewhat approaches the turtles in form, and may be considered as a link joining them to the pigeons, from which it differs in having rather longer tarsi, and in the outer toe being slightly shorter than the inner.

It is a denizen of the thickest jungles, coming to the more open spaces to feed. I have seen it in Goomsoor, in Malabar and the Wynaad, and near the top of the Neilgherries, on the Coonoor pass. It feeds chiefly on the ground on various seeds, is solitary, a shy and wary bird, and of very rapid flight. Irides orange. Length nearly 12 inches.

Gen. TURTUR, Selby.—*Fachtah*, H.—*Doves.*

292.—*T. tigrinus.—Col. tigrina*, Temm.—*Chitroka Fachtah*, H.

This handsome dove is most abundant in the neighbourhood of, and

among thick and lofty jungles. It is, however, also met with in groves of trees in the neighbourhood of the more wooded villages and towns, both in the Carnatic and Deccan.

Irides lake red; length about 12 inches, of which tail is 5. I have seen a nearly albino variety of this bird once or twice, being of a pinkish white colour throughout.

293.—*T. Cambayensis.*—*Col. Cambayensis*, Lath.—*Tortroo Fachtah*, H.

This little dove abounds over most of India, both in low jungles and near villages and cantonments, being found especially towards the north in every garden, and frequenting stable yards, houses, &c.

Irides dark brown.

294.—*T. risoria.*—*Col. risoria*, L.—*Dhor Fachtah*, H.

This large dove is found over all the country, frequenting hedges and trees in the neighbourhood of cultivation, also low bushy jungle.

Irides fine ruby red.

295.—*T. humilis.*—*Col. humilis*, Temm.—*Serotee Fachtah*, H.

Found, though more rarely than any of the last, over all India, frequenting groves of trees, hedge rows, &c. in the neighbourhood of cultivation.

Irides dark brown.

None of these four doves are gregarious, being generally found in pairs, though at certain seasons they occasionally congregate in flocks of various size.

296.—*T. meena.*—*Col. meena*, Sykes.—*Col. Turtur*, var. ?—*Kullur Fachtah*, H.

I have hitherto only found this species of dove in the jungles of Goomsoor, where it is tolerably abundant, associating in flocks of various size. It is enumerated by Mr. Elliot as found in the Southern Mahratta Country, but I did not observe it in the forests of Malabar.

Irides orange. Length 13 inches.

(*To be continued.*)

II.—*List of Minerals for presentation to the Society, collected from various parts of the Nizam's territories, Ceded Districts, Kurnool, the Southern Mahratta Country, Mysore, &c.—By Lieut.* T. J. Newbold, *23d Light Infantry.*

No. 1.—A. Gneiss of Dummul at the base of the Kupputgode hills, Southern Mahratta Country, the weathered transition gneiss of Christie.

No 1.—B. Not weathered variety, same locality, with pale rose-coloured felspar.

2.—Mica schist, compact variety, Kupputgode hills. Before the blow-pipe, *per se*, in the platinum forceps, this rock fuses into a black enamel.

3.—Yellowish brown jaspery chert, same locality as the above, used by Hyder and Tippoo for gun-flints; fracture conchoidal, translucent at edges.

4.—Basanite, or flinty slate traversed by quartz veins, associated with the schists of the Kupputgode range.

5.—Lateretoidal rock, into which the higher and more ferruginous portions of the schists, composing the Kupputgode hills, pass.

6.—Black oxide of manganese, combined with oxide of iron and alumina: with decomposing quartz and felspar veins: thee xterior exhibiting a disposition to the botryoidal structure.

7.—Variety of the above.

8.—Do. do.

9.—Porphyritic chlorite rock. Pale rose-coloured crystals of felspar imbedded in a siliceous paste, coloured by chlorite; some of the crystals decomposing into a whitish clay. This rock is associated with the siliceous chlorite schist of the Kupputgode hills. Although, petrographically considered, it might be correctly pronounced a porphyry, yet I have preferred the name just given it, as more in keeping with the geognostic position of the rock. This rock I have seen in various parts of Mysore and the Ceded Districts, associated with granite and the primary schists.

10.—A. Chlorite slate, same locality.

10.—B. Do. siliceous variety, exhibiting the tendency of this rock to split into rhomboids.

11.—Siliceous mica slate, same locality, showing traces of copper.

12.—White sub-crystalline limestone—the more granular varieties closely resemble Carara marble—in veins in the schistous diorite, Kupputgode range.

13th.—Do. do. altered in colour, near line of contact with the slate.

14th.—Rhomboidal calc-spar, same locality.

15th.—Singular calcareous rock; composed of minute angular fragments of a dark glistening quartz, and crystals of pale flesh-coloured felspar, cemented together by a greenish, granular, sub-crystalline paste, composed chiefly of carbonate of lime. It occurs in a hill near the village of Hurti, on the southern flank of the Kupputgode range, not far from the Putwurden's territory. The hill has a mammiform shape, having its surface covered with detached angular and rugged masses of this rock, which appear to have been subjected to the action of violent disruptive force. It is very likely to be mistaken, from the colour, hardness and granular texture, for a variety of massive siliceous chlorite rock, and in some specimens resembles diallage and serpentine; but on the application of a lens, and indeed by the naked eye, on closer inspection, its true aggregate character may be distinctly recognized. The application of dilute nitric acid to the rock in substance excites but a feeble effervescence; but on the powder the extrication of carbonic acid gas is abundantly evident. It often imbeds cubic pyrites of iron. The felspar, the dark quartz crystals, and dull green hue of the rock, possibly indicate its origin from the chloritic slates of the Kupputgode hills.

16.—Variety of the foregoing, less crystalline in texture, imbedding cubic brass and liver-coloured pyrites. Colour, dull green, with reddish brown delineations, assimilating some varieties of serpentine. From the minute glittering scales of mica, observable in this rock, and its softer texture, it would appear to have been formed out of the debris of the neighbouring mica slate. It effervesces with the dilute mineral acids: before the blow pipe, *per se*, it phosphoresces slightly, and exhibits on its edges shining points of black enamel. The compact varieties of this rock are susceptible of a high polish, and are used as an ornamental building stone. Some of the exquisitely polished slabs in the elaborately sculptured little mosque in the town of Lachmaisir, in the territory of the Mahratta Chintaman Row Putwurden, are of this stone, retaining the pyrites which shine like so many spots of gold on its polished surface. The chlorite slate too of this part of the Southern Mahratta Country imbeds pyrites.

17.—Variety of the above, with cubic liver and gold-coloured pyrites, projecting from the weather-worn surface None of these rocks have been noticed either by Christie or Colonel Sykes.

18.—Clay slate of Darwar, red and white, noticed by Christie, composed principally of decomposed felspar, more or less coloured with iron, and having a loose aggregation. Chlorite also occurs; and to the presence of this mineral may be attributed the peculiar shining flaky structure, and the greenish tinge of many of the surrounding slates.

The specimen is from a bed of slate that has suffered considerable flexure from the intrusion of a dyke of basaltic greenstone, and from its softness assimilates the character of a shell or slate clay. Before the blow-pipe the whiter portions melt, *per se*, into a white enamel; the red parts blacken at first, and fuse with some difficulty into a shining black slag, more or less affected by the magnet.

19.—Dark blue roofing slate of Kulladghee, occurs both laminar and massive, it is easily cut by the Wudras on the spot into excellent writing or roofing slates. Some varieties are so massive that pillars, many feet in height, are quarried from it, and some so finely lamellar that leaves, two or three feet square, almost as thin as pasteboard, may be separated. A capital writing slate and pencil were cut for me out of the quarries, and shaped and polished, all in a couple of hours. This formation furnishes good hones ; specimens of which I have already furnished.

20.—Variegated clay slate, penetrated by calcarious infiltration, associated with transition limestone of Kulladghee.

21.—Chlorite slate, of Kittoor.

22.—Talc slate from the Falls of Gairsipa, Western Ghauts, reddish grey ; less weathered portions, greenish grey ; streak nearly white, sectile, greasy feel, structure laminar tables, glimmering lustre, translucent at edge, easily frangible. Almost infusible before the blow-pipe, the plates separate and whiten.

23.—Actynolitic schist, associated with the talc, mica and hornblende schists at the Falls of Gairsipa. Minute acicular crystals of actynolite, without any common direction, distributed irregularly throughout the structure of this rock, impart a glimmering appearance ; a few scales of mica are disseminated: colour grass green, feel harsh, easily frangible, fracture granular, inclining to slaty, streak greenish grey. Before the blow-pipe, *per se*, it first whitens and finally fuses into a green enamel.

24.—Hornblende schist or schistous diorite, Falls of Gairsipa, identical with the rock described by Christie, as consisting almost entirely of hornblende.

25.—Mica schist, Falls of Gairsipa.

26.—Do. do. imbedding decaying garnets in dodecahedrons.

27.—Mica schist passing into gneiss—same locality as the above.

28.—This is the rock described by Christie, as being a variety of granite, which differs from the common granite of India, and as not being so old ; composed of small grains of white felspar, quartz, and mica ; has, in some instances a slaty appearance, and is associated with gneiss and hornblende schist.

From a careful examination of this rock and its associated schists, *in*

situ, and from its decidedly stratified character, I should rather be inclined to pronounce it thick bedded or granitoidal gneiss ; in some hand specimens, however, it is not to be distinguished from true granite. It is an interesting specimen to the advocates daily gaining ground, of the theory of the mineral metamorphism of rocks, constituting one of the almost imperceptible gradations by which a normal rock is supposed by Keilhan and others to pass into rocks, generally considered abnormal, or in other words involving doubts as to the plutonic origin of granite. Gairsipa, not only affords to the geologist an instructive and beautiful exposé of the rocks of the gneiss and mica schist system, the dip and direction of strata, but affords to the lover of nature, the magnificent spectacle of one of the most stupendous (in point of height) cataracts on the face of the globe, tumbling over a precipice of these rocks more than eight times the height of the celebrated Falls of Niagara. The breadth of the river above the Falls is about 300 yards ; it was full from bank to bank at the time of my visit : the depth of the stream on the average about 10 feet. The sheer height of the scarp over which the waters were precipitated, according to careful measurements, twice repeated, communicated to me by Mr. T. Lushington, 888 feet to the surface of the water in the basin, and the depth of the basin 300 feet, making a total of 1188 feet. The height of Niagara is about 140 feet, but the breadth of the river far exceeds that of Gairsipa.

29.—Gneiss of Gairsipa, hornblende replacing mica, which appears in scales, disseminated among the former mineral.

30.—Variety do. do.—same locality.

31.—Gneiss passing into hornblende schist—same locality.

32.—Talcose pot-stone (*lapis ollaris*), associated with the talc slate in the S. E. part of the Darwar district. Christie observes, that all "the fine plaster with which the walls of the houses are covered in India, and which is so much admired by strangers, is composed of a mixture of fine lime and soapstone, rubbed down with water : when the plaster is nearly dry, it is rubbed over with a dry piece of soapstone which gives it a polish very much resembling that of polished marble." This stone I have also found associated with asbestus in the talcose slate of the western parts of Mysore : it is cut into pencils and used by the natives for writing on cloth, stiffened and prepared with charcoal, and is held in holy estimation both by the Brahmins, the Jangams and laity of the Lingayet sect. By the former it is hollowed out into vessels used in preparing their food, and by the latter for their phallitic emblem, which is preserved inviolate from unhallowed gaze in the small silver box, which the worshippers of the *lingum* invariably carry about their per-

ons for the purposes of adoration. Some varieties are used in parts of the Ceded Districts and Mysore to grind the sandal wood into powder, for the composition of the *ticá*, with which some castes of the natives mark their foreheads. An argillaceous variety procured between Tarputtri and Cuddapah is carved, like the agalmatolite of China, into images representing the whole Hindu pantheon, avatars of Vishnu, &c. The darker and more compact varieties often assimilate serpentine, and take a fine polish. This stone is in great request for the larger kind of idols that usually sit or stand enshrined in the *Vimanas* of Hindu temples, and many of the ancient inscriptions of the Southern Mahratta Country, Mysore, the Nizam's territories, are engraven on pillars or blocks of this mineral. Some of the beautifully polished pillars, and inscribed slabs in the ruined temples of the old Hindu capital of Bijanugger and Annagundi are of this stone. In Mysore, whole temples are constructed of it. The dark coloured stone, of which the pillars supporting the elegant mausoleum of Hyder and Tippoo, near the Lal Bagh at Seringapatam, are composed, appears to me, after a close examination of the pillars themselves and the quarries at Turivicary, whence the stone was brought, to be a highly indurated ferruginous, and crystalline variety of this rock, having some of the characters of a serpentine, rather than the basaltic or hornblende rock, which Buchanan and Benza have severally pronounced it to be. Specimens of this variety taken from the quarries of Turivicary, and also of the potstone of Mysore, I have forwarded for presentation.

33.—Marble from Kulladghee, pale flesh-coloured, occurs in beds and veins in the surrounding slates and limestone, assimilating in texture, colour and fineness of polish the Tiree marble, but does not imbed mica, hornblende, or sahlite: chlorite, however, is sometimes seen in their greenish seams. Specimens of the lithographic limestones near Kulladghee and Bagalcota, have been already transmitted to the Society.

34.—White marble from Bagalcota, streaked with green chloritic zones resembling the antique Cipolin marble.

35.—Lithographic limestone from Kurnool, imbedding stalactiform oxide of iron.

36.—White marble from Kulladghee.

37.—Drab-coloured limestone from Talicota, in the Rastea's territory, laminar and compact, exhibiting delicate arborescencies between the laminæ, or layers of deposition.

38.—Crystalline limestone, approaching marble in texture, from Kurnool. Colour mottled green and white; translucent in thin fragments, difficultly frangible, some varieties are so hard as to give fire with steel,

fracture granular crystalline. This stone is susceptible of a fine polish, and might be employed with advantage in ornamental slabs for inscriptions, vases, &c. It occurs near the line of contact with the schistous chlorite, from which it probably derives its peculiar hardness and colour.

39. Lim estone of Kurnool altered by contact with the schistous chlorite; colour, dull green, streaked with dark purplish ferruginous bands; fracture granular, sub-crystalline, extremely tough under the hammer, effervesces feebly with dilute mineral acids. Some varieties imbed pyrites and assimilate serpentine. It occurs at Kurnool, and on the tongue of land between the confluence of the Tumbuddra and Kistnah rivers.

40th.—Quartz rock of Darwar, coloured with iron, and containing nests of decayed quartz and felspar, passing into kaolin, and often tinted yellow, brown, and reddish by oxide of iron. In the hilly zone extending between Kittoor and Darwar, there is a variety that exactly resembles the rock composing the upper portions of the copper mountain and Sondur ranges, being of a jaspery and highly ferruginous clay, sometimes passing into a true ore of iron, with a cherty quartz in alternate layers, generally on their edges, and varying from the eighth part of an inch, to an inch in thickness. The laminæ are frequently contorted and bent, and impart a curious waved or striped appearance to the rock. It occupies a similar geognostic position, and is seen generally cresting the slaty hills around Kittoor. Sometimes, as Christie accurately observes, the base of the rock is white or grey, and traversed in all directions by dark brown-coloured veins, highly impregnated with iron: but in some specimens, the dark brown variety is in much larger quantity than the white basis; and then the latter appears as if it had been broken into a number of small angular fragments, which had afterwards been united by the consolidation of the brown variety from the fluid form. This variety contains numerous small cavities which are lined with red hæmatite in the shape of stalactites, or having a blistered, or mammillary form. The cavities are generally very small. This rock in petrographical structure and geognostic position, we may safely pronounce to be identical with that composing the precipitous sides of the Bimagundi pass into the Sondur valley (described at page 147 Journal No. 20); and associated with it, we find, near Kittoor, as at Sondur, a magnetic iron ore with polarity, exhibiting a similar laminar structure and a like tendency to split into rhomboidal paralellograms.

41.—Breccia, of the old red sandstone formation of Christie, from the north bank of the Malpurba, Southern Mahratta Country; a reddish brown

quartzy paste imbedding angular fragments of white and reddish quartz, with felspar disseminated.

42.—Do. do. a ferruginous paste, cementing fragments of a decomposing chert, apparently from veins in the associated limestone; the paste approaches a true iron ore, and contains small cavities lined with a mammillary hæmatite.

43.—Pudding-stone from the old red sandstone formation, north of the Malpurba :—rounded pebbles of quartz rock imbedded in a crystalline reddish brown sandstone.

44.—Diaphonous quartz with a bluish tint, mentioned by Christie, associated with the sandstone; from the hill south of Kulladghee and near Padshapoor. I have forwarded specimens of the white variegated sand stones of Badami and Mudibhal.

45.—Alum in whitish earthy superficial efflorescences between the laminæ and on the air-exposed surfaces of a purplish aluminiferous shale, alternating with the old red sandstone, in the cliffs at the falls of the Gutpurba near Gokauk. The occurrence of this mineral in the formations of the Southern Mahratta Country appears to have escaped the observations of Marshall, Christie and Sykes. It is found in the lower portions of the cliffs, constituting the precipice over which the Gutpurba rolls on its passage to the low country, through which the Kistnah flows, at the bottom of one of those singular and deep fissures that clear the sandstone rocks from summit to base. The shale in which it occurs is a common slate clay, of a purplish brown hue, and tastes, generally, distinctly of alum, which, however, rarely appears in an efflorescent state, save on air-exposed surfaces : it does not resemble in the slightest degree the globular greyish black alum slate of Europe, nor its bituminous aluminiferous shale. I have also discovered alum and common salt in the rocks of the copper mountain range in a similar efflorescent state, in a rock, resembling somewhat the glassy alum slate of mineralogists, but cellular, ferruginous, and exhibiting purple and yellow iridescent hues. Captain Arthur informed Sir Whitelaw Ainslie that he discovered alum in Travancore, in a soft dark coloured laminated earthy matter, which contained sulphur in the state of sulphuret of iron; and that at certain depths in the soil, under the laminated matter, he observed a regular stratum of charcoal, a circumstance which led him to conjecture that the bed in which the mineral is found is of a vegetable origin; and we know that it has been ascertained by Vauquelin and others that in what is termed the alum ore of *La Tolfa*, potass is met with in considerable quantity. Alum is associated with the coal measures and bitumeniferous rocks of Europe, its existence therefore in the sandstone rocks of

the Southern Mahratta Country may be regarded with some interest, as indicative, if not of the existence of coal, at least of the age of the formation. Alum, we are told by Dr. Davy, exists in certain caves in the interior of Ceylon. Mr. Elphinstone states that it exists in the clay of Calabaugh in Cabul, and according to Captain Macdonald Kinneir it is found in the mountains south of Kelat, in the province of Mekran. It is also brought in considerable quantities from the mountains of Nepaul, where according to Mr. Campbell, it is said to exude from the surface of soft rocks, and sometimes to be dug out of their substance; from these sources it is collected in considerable quantities, during the cold and dry seasons, and carried by the *Bhoteahs*, *Murmis*, and other hill people, to Katmandu, to be exchanged with the merchants of that city for money or other articles. Mr. Campbell also informs us that there is a dark bituminous substance, used in Nepaul, said to be exuded from rocks; which is called black alum or *salajit:* it resembles, in external character, the bituminous alum ore which is said to be found in Sweden, and in many coal mines in England, but there is much vegetable matter in it, although the Nepaul physicians believe it to be a mineral. Alum also exists in Behar, where it was discovered by Dr. Buchanan, and also in the Vindhya mountains, but the great bulk of this valuable mineral, which is used extensively by the natives of India in medicine and the arts, is imported from China.

46.—Secondary trap of Christie, from the vicinity of Belgaum—vesicular.

47.—Amygdaloid (same locality) imbedding zeolite and calc-spar. A more compact variety occurs imbedding nodules of calcedony. This rock escaped the observation of Christie, who states he never saw the amygdaloid in sitû.

48.—Lateritic conglomerate, capping slate and limestone of Kulladghee.

49.—Laterite of Beder—Nizam's territory.

50.—Variety do., exhibiting interior of tubular sinuous cavities, having a greyish green indurated enduit.

51.—Variety do. do. compact—Beder.

52.—Do. do. near the line of contact with flœtz trap—Beder.

53.—Do. do. with a somewhat cancellar structure—Beder.

54.—Indurated lithomarge bed, between laterite and trap—often calcareous—Beder.

55.—Variety of laterite with cavities filled with white lithomargic earth—Beder.

56.—Purple lithomarge in laterite of Beder.

57.—Flœtz trap, near the line of contact, where the laterite is seen superimposed—Beder.

58.—Basalt underlying laterite cliffs of Beder.

59.—Termination of black veins in the laterite of Beder, near its junction with the trap, in combination with iron and alumina.

59 A.—Black oxide of manganese in combination with iron, from veins in laterite of Beder.

60.—Lateritic conglomerate, capping laterite of Beder. It exactly resembles a similar rock, distinct from the true laterite, capping the laterite of the ghauts and Western Coast, composed of ferruginous nodules, cemented together by a felspathic paste of various shades of yellow, brown, and red, coloured by oxide of iron. This rock occasionally presents a shining glazed-like surface. In tracts where travertine and limestone prevail, as in the vicinity of Bijapore, and Baugwari, the lime often enters the cement of this conglomerate.

61.—Nodule in laterite of Beder, imbedding a mineral, with a green and purple iridescent hue, probably iron.

62.—Laterite of the western ghauts—Devamani pass, Upper Canara.

63.—Lateritic conglomerate, capping laterite of the western ghauts, summit of Hossdroog pass, Upper Canara.

64.—Laterite of the Western Coast, quartzy variety, from Onore. Specimens of this rock from the Malayan Peninsula, Cannanore, Mangalore, the Bisley and Heggalla Passes, the lateritic rocks capping the slate and sandstone ridges of the Ceded Districts, the neighbourhood of Bangalore and Nundidroog, &c. have already been transmitted.

65.—Variety of laterite from Onore—felspathic.

66.—Do. do. Western Coast, from Compta, north of Onore, exhibiting the externally black superficies, so often noticed in the weather exposed masses of this rock.

67.—Variety from base of western ghauts, near Meerjan.

68.—Do. do from the vicinity of Soonda, in Upper Canara.

69.—Do. do. from Banwassi, in Upper Canara, near the western boundary of Mysore.

70.—Lateritic conglomerate, capping the laterite cliffs which overlie the flœtz trap formation of the Deccan ; hills near the city of Gulberga—Nizam's territories

71.—Greenish white felspathic sandstone, of an earthy friable texture, with small angular fragments of quartz, associated with the overlying trap at Bangwari, near Belgaum. It sometimes imbeds dark ferruginous nodules in a state of disintegration.

72.—Travertine with dendritic appearances, between Hyderabad and Beder.

73.—Amygdaloid associated with the great overlying trap formation of the Deccan, containing globules of a species of zeolite, resembling apophyllite in its behaviour before the blow-pipe—frosted pearly exterior, and peculiar splendent planes. It exfoliates, curls, and froths, before the blow-pipe, and finally melts into a white enamel. This amygdaloid also contains calc-spar, mesotype, and stilbite. It is from Ipperghi, near the boundary of the Solapoor Rajah's country.

74.—Stellated zeolite in rhomboidal calc-spar, Solapoor territory. This is an interesting specimen, showing the gradual pseudo-morphic changes of the two minerals. A white zone appears to define the limits of each, beyond this they become in a certain degree blended: the zeolitic rays may be seen decussating and diverging from their several centres, through the transparent substance of the calc-spar.

75.—Radiated zeolite—rolled fragments from the bed of the Bhima—Nizam's territories.

76.—Red jasper from the Kistnah—do.

77.—Yellow jasper from the Malpurba—Southern Mahratta Country.

78.—Mocha stone, enclosing nest of quartz, bed of the Bhima.

79.—Cornelian—bed of the Kistnah, at Paugtoor.

80.—Calcedony—botryoidal, from the vicinity of Ipperghi—Solapoor Rajah's territory.

81.—Oriental agate.—Numerous specimens of this beautiful mineral, some assimilating the onyx, sarde, and sardonyx, I have already forwarded to the Society, as also of glauconite, various kinds of zeolite, chrysoprase, heliotrope, &c., occurring in the flœtz trap formation of the Deccan.

82.—Agate imbedding quartz.

83.—Moss agate—bed of the Kistnah, at Paugtoor.

84.—Amethystine quartz crystal, from Golconda—Hyderabad.

85.—Do. do. from Cupputral, Ceded Districts, where the sandstone comes in contact with the granite.

86.—Pale buff coloured sparry limestone, associated with the overlying trap formation of the Deccan and the laterite. Locality, hills of Ingliswara, near Baugwari—Bijapore territory.

87.—Variety—reddish.

88.—Limestone, greyish white, imbedding broken fragments of bivalved shells, converted into chert, associated with the overlying trap formation near its southern limit, between Hyderabad and Beder.

89.—More compact variety—same formation near Firozeabad, Nizam's territory, imbedding both univalve and bi-valve shells.

90.—Do. do. same formation from the vicinity of Koolkondah, presented by my friend Lieut. Wyndham.

91.—Do. do. pale buff coloured, imbedding nummulites.

92.—Variety, whiter and more crystalline. Both the last named specimens were found on the river bank at Onore on the Western Coast, and, if credit may be attached to enquiries made on the spot, were brought thither by native trading craft from the coast to the northward as ballast. Fossiliferous limestone, we know, occurs in the Kattywar peninsula, and the island of Perim, but the natives assured me the nummulitic limestone at Onore, was brought from places considerably to the south of these places. It is possible, however, that the spot where they were picked up by the native boatmen is at some distance from their true situs, as all the fragments have a rolled and water-worn appearance, as if they had been washed by the tidal wave on a sea coast. A piece of coral rag with shells *(ostrea)* adherent, was also picked up among the fragments of limestone at Onore. It would be matter of some interest to ascertain from the boatmen themselves, the exact localities where they took in these stones as ballast. My visit to Onore was extremely brief, and during the monsoon, when no boats can approach the coast, and all trade by sea suspended. Nummulitic limestone occurs at Chirra Punji. Burnes observed nummulites in the limestones of the Chari range at Liseput, in Cutch. Mr. Colebrooke first brought this rock to notice in 1824. It was met with at the foot of the Kasya mountains. Shell limestone, I believe, was discovered in the Madras presidency by Colonel Cullen, at Paddapangallee, in the Northern Circars, underlying basalt, and in the Hyderabad territory, by Voysey, in 1819-20. Malcolmson and Benza have since added to these discoveries.

93.—Hexahedral pyramid of adamantine spar, bluish white, from the Corundum pits, in the west of Mysore near Gram. This mineral is almost confined to India and China, and has been long known in the former country under the term of *Korund*—hence its European name. It is used principally in India, Ceylon and Arabia, for polishing precious and other stones. The oriental ruby, sapphire, and topaz, are varieties. Corundum occurs in Ceylon, Mysore and Cuttack; it is rare in Europe, though a sub-species, emery, is found in abundance on the island of Naxos, near Smyrna and in Saxony.

94.—Green copper ore (malachite) from the copper mountain near Bellary. Before the blow-pipe, *per se*, it decrepitates, but finally fuses into a reddish brown mass, containing a bead of pure copper. Treated

with acids it affords from re-agents the usual indications of this metal.

95.—Iron glance, imbedded in white quartz, from the hills of Cupputral, Ceded Districts, the *fer oligiste* of French mineralogists. Before the blow-pipe, *per se*, it blackens and becomes affected by the magnet. Iron glance yields an excellent malleable ore.

96.—Granular magnetic iron ore, from Mutpalle—Nizam's country.

97.—Red hematitic iron ore, from the iron clay near Kondassur—Nizam's country. The iron produced from the two last named varieties is used when blended to produce the celebrated wootz steel, which is exported to Persia and Arabia for sabre blades.

98.—Specular iron ore—Sondur hills, Ceded Districts. It, as well as the micacious iron ore, is often sold as *surmah*, or antimony, in the bazaars of Southern India, and applied in the state of a powder to eyelids of women and children.

99.—Lead ore (galena) near Jungumrazpilly, in the Nulla Mulla hills, north of Cuddapah, said to be combined with silver and antimony.

100.—Gold dust in magnetic iron sand with menaccanite, silver and copper ore (and platinum ?) in the bed of the Doni rivulet, Kupputgode hills, South Mahratta Country.

101.—Native silver—same locality.

102.—Grey silver ore—do.

103.—Green carbonate of copper—do.

104.—Native copper—do. do.

105.—Tin ore (oxide) from Malacca.

106.—Diamond alluvium; from the diamond pits at Ramulacota—Kurnool.

107.—Do. do. last washings.

108.—Cacholong, milk white, opaque, fracture semiconchoidal. This specimen presents both the hard and the soft earthy varieties, noticed by Brongniart in the cacholongs found by him at Champigny, the former exhibiting a shining fracture, while the latter is chalky, light, and adheres to the tongue.

109.—Brown indurated clay, imbedding quartz crystals, and covered with yellowish annular and lenticular delineations, assimilating organic remains, associated with laterite, resting on the flœtz trap of the Deccan, south of Bijapore.

*110.—Mineral from edge of trap dyke, near Tallapodatoor, Ceded Districts.

111.—Nodule of indurated clay from lateritic formation—Nellore.

* I regret leisure will not admit of my noting this mineral.

112.—Asbestiform tremolite, found in veins, with adularia and magnetic iron ore in mica slate—Adepuram, Nellore mining district. It occurs in minute diverging fibres, with silky lustre, often stained by oxide of iron, frangible, scratches glass with difficulty, phosphoresces slightly, and whitens before the blow-pipe.

113.—Adularia associated with the above; scratches glass, lustre splendent, rather vitreous on the perfect planes, and pearly on the broader lateral planes. Before the blow-pipe, *per se*, it whitens and fuses on thin edges into a transparent glass. It is about 6° hardness of Mohs.

114.—Do. imbedded in kunker—same locality as the above.

115.—Variety of iron ore, resembling externally the titaniferous iron ore of the Neilgherries; after exposure to a red heat it becomes magnetic. It occurs in compressed laminæ, in seams of a garnetic quartz bed in the mica schist at Kunchgarlconda—Nellore.

116.—Garnetic quartz bed in mica schist—Kunchgarlconda.

117.—Honey-combed quartz: most of the cavities are filled or lined with an orange brown powder, which, before the blow-pipe, blackens and becomes magnetic.

118.—Quartz with magnetic iron ore foliated, garnets and mica, and exhibiting traces of copper, Ademulepuram—Nellore.

119.—Do. do. with rhombic dodecahedral garnets, resembling essonite.

120.—Granular garnet rock—same locality. This rock from its apparent weight, hardness, colour and tendency to take a crystalline form, might easily be mistaken for granular corundum at first sight. It is finely granular in structure, and has the appearance of a purplish red jasper. It often occurs in nodules which assume a rudely dodecahedral form or prisms, with three sided summits. It occurs in beds in the hornblende and mica schists of the Nellore mining districts, near Gurumanypenta, associated with asbestiform tremolite and adularia. Like precious garnet, it fuses, *per se*, before the blow-pipe into bluish black enamel.

121.—Red mineral in shining plates, resembling felspar, between laminæ of mica schist, base of Udeghirry mountains—Nellore. Softer than felspar, streak reddish white. Before the blow-pipe, *per se*, fuses easily with intumescence and phosphorescence, and curling up into a white enamel; with phosphate of soda into a topaz coloured glass, which becomes colourless on cooling, and with borax into a faint greenish glass, which also loses its colour on cooling.

122.—Pale rose coloured quartz—same locality.

123.—Gravel, brought down by mountain torrents, containing rolled and angular fragments of iron ore, garnets, schists, and copper ore.

124.—Mica schist with garnets and carbonate of copper—Gurumanypenta, Nellore mining district.

125.—Carbonate of copper in layers in hornblende schist—Bungeral Mettah, Nellore mining district. Mr. Prinsep thinks the phenomenon of the ore alternating with the hornblende interesting in a geological point of view, as affording exactly the appearance of gradual deposition from a liquid, at this earliest period of geological formations. But when we see, as in some specimens of this very rock, the ore running through it in fissures and lines nearly perpendicular to those of stratification, we must look to some other cause than a mechanical deposition from a liquid to account for its occurrence in such situations, and pause ere we pronounce the ore to be coeval with the primary rock which imbeds it.

126.—Mica schist, in which the mica is, in part replaced by innumerable small garnets, imparting a granular structure to the rock.

127.—Specimens of the copper ore, principally from Gurumanypenta, Bungeral Mettah, Salighirry and Yerrapully—Nellore: they present for the most part the carbonate passing into malachite and mountain blue. Some fragments have a quartzose matrix; both coloured green, and appearing so, from the imbedded ores—another variety runs in veins through a dark red oxide of iron, which Prinsep considers, to be the same as that of Dr. Thomson's specimen. (These ores have been analyzed in England, by Dr. Thomson, and more lately in India, by Mr. Prinsep, vide Madras Journal, for April 1836, p. 154). The mixture of sulphuret of iron, according to Prinsep, and perhaps of copper, with the oxide, gives the whole a dark arenaceous character. The first ore yielded 30.2 per cent of metal, and the last 39.5.

128.—Copper ore with grey metallic lustre internally, and penetrated with green streaks: probably the combination of the carbonate and sulphuret, mentioned by Prinsep as the richest ore met with, and yielding 69 per cent. of pure copper; highly malleable; specific gravity, interme diate between the carbonate and sulphuret.

129.—Schorl crystallized in prisms with quartz, mica and traces of copper: much finer crystals of this variety of tourmaline may be obtained from the locality whence these were obtained, but I had not the means of detaching them from their bed, which occurs in the mica schist of Bungeral Mettah, Nellore mining district. This variety of schorl *differs* slightly from that of Europe. It melts into a greenish grey enamel, instead of a black slag—hardness between quartz and topaz. With borax it fuses into a transparent glass tinged green.

130. Dark brown calcareous rock, structure passing from earthy to that of a fine indurated clay, associated in thin overlying beds with the plumbiferous limestone of Yungumrazpilly. It imbeds whitish tubular bodies, lined with minute whitish crystals (organic exuviæ ?).

131.—Do. do. with quartz and decomposing iron pyrites.

132.—Nodule of iron ore (magnetic) from Kunchgarlconda, Nellore, granular metallic lustre; colour brownish black, streak brown, opaque, fracture uneven, infusible before the blow-pipe, *per se*, with borax it melts into a green glass.

133.—Quartz rock—Udeghirry Droog.

134.—Asbestus, in masses of fibres, passing from a dull greenish grey to a yellowish white mottled colour, with a slight soapy feel. Tough under the hammer, and breaks into fibrous woodlike fragments, which are not flexible in an unseparated state. It is found in a bed at Putsa Marculpilly, near Rayel-cherroo, Ceded Districts, in limestone, associated with a white indurated magnesian clay or earth. Before the blow-pipe, it fuses into a greenish grey enamel, which by a continuance of the reducing flame is converted into a brown slag.

135.—Magnesian earth indurated, associated with the above—same locality.

136—Indurated earthy vein in mica slate—Bungeral Mettah, Nellore. Colour faint reddish, white with scales of mica disseminated, effervescences feebly with acids.

Actynolite, carbonate of magnesia, and kyanite, occur in the mica and hornblende schists of the Nellore mining district, also a magnetic iron sand which is smelted, and abundance of hematitic iron ore. The soil often presents a sterile waste from the saline effervescences of the mineral alkali; muriate of soda, and saltpetre, often attending metalliferous development.

III.—*Remarks upon the Auriferous Deposits of India, considered with especial Reference to their Economical Value.—By* Frederick Burr, *Esq.*

My attention having some years ago been directed to the geological structure and mineral capabilities of India, one of the facts which then struck me with regard to the latter subject, was the very extensive oc-

currence of auriferous deposits in various parts of the Indian peninsula. The impression made upon my mind at the time with regard to the immense diffusion of this metal, has during my residence in this country been fully confirmed—it is an important, though almost unheeded fact, that gold is very generally distributed, though in sparing deposits, throughout extensive tracts in India, extending from the tenth to beyond the thirtieth degree of north latitude. There is every reason to believe, therefore, that this metal might be made a new source of revenue to the state, of wealth to the country, and a profitable object of occupation to its population, were sufficient skill and attention devoted to the subject. It is with this object in view, that the following remarks have been written.

From the comparative rarity of practical science, among those observers to whom we are chiefly indebted for our knowledge of Indian mineralogy, it is not, I fear, possible to obtain from the details they have furnished us, any very clear or definite knowledge of the *actual richness* of these gold tracts. They are generally described as being poor, and containing the precious metal in very small proportions, but the poverty of metallic ores thus expressed, is entirely a relative term, and liable to much ambiguity. What it would be desirable to know, is the actual quantity or *per centage* of the precious metal, which can be extracted from a given quantity of mineral matter; with this datum we might form a correct idea of the value of the mineral, though it would still be desirable to know the cost of production, and the means of washing or reduction employed, as after all much would depend on the greater or less perfection of these processes. Gold except in a few rare cases, is always found in very sparing quantities, compared with the mass of sand, veinstone, or other mineral substance which accompanies it; which is in fact the principal cause of the high relative value of this metal: yet many auriferous deposits are by good management made to yield a profit by the skilful mining Engineer, which to the uninstructed eye would appear either totally destitute of the precious metal, or so poor as to be absolutely worthless.

Without attempting to describe, or even to point out every locality in this country, where gold has been ascertained to exist, I shall commence by briefly enumerating such of those tracts as now occur to me, and will most readily confirm my views of the abundant distribution of the precious metal throughout a large portion of the Indian peninsula.

Taking first the Madras presidency, gold is well known to occur in Coimbatoor, in numerous localities on the western and southern de-

clivities of the Neilgherry mountains, and other parts of the Malabar Coast, where it is commonly found disseminated in small particles in the sands and beds of rivers, and may be estimated to spread over an extent of several hundred square miles, forming the principal gold tract of Southern India. In the high table land of Mysore, gold is known to exist in many places, as near Bangalore and Chinnapatam, and in the Wynaad district. In the Southern Mahratta Country, the existence of gold is well known, and the deposits of the Kupputgode range have been described in the "Madras Journal of Science," by an energetic labourer in the field of Indian geology—Lieutenant Newbold. In the Northern Circars, and the Rajah of Berar's territory, gold is described as existing in many of the rivers, especially in the Nagpore district, almost the centre of India. I have also been informed by W. H. G. Mason, Esq. that the natives obtain a little gold by washing, in the streams near Vizagapatam.

This very brief and imperfect review of auriferous localities within the Madras territories, would be amply sufficient for our present purpose; yet it is deserving of notice, that these deposits of the precious metal, are equally abundant in the northern portion of the Indian peninsula as in the southern, as I shall now proceed to show.

Gold is known to exist in the tributaries of the Indus, in Kumaon, where it is obtained by washing in the streams in the vicinity of Kalsee. That these auriferous particles are derived either from the rocky escarpment of the Himalayahs, or the mountains subordinate to them, is highly probable, as gold mines are described as being worked by the Chinese Tartars north of these mountains near Hurtoh, beyond the lake Mansuraor. These gold workings are said to have been stopped by order of the Chinese government, lest the precious metal should be the means of tempting us across the snow clad pinnacles which bound the British territory. Gold is stated to occur in great abundance in Assam, where it is profitably worked by the natives at Gowhetti, on the Bramahputra. From this point deposits of gold are well known to extend southward through the Burmese empire, the Malayan peninsula, and the adjoining islands, but these localities it would be foreign to my present purpose to notice.

Of the actual economical value of this prodigious range of auriferous deposits, which has been shown to extend so widely over the Indian peninsula, little or nothing is, I believe, known. There is, however, the simple fact before us that in many places they have been worked by the natives, who must therefore have been able at least to obtain a subsistence from their labours, although carried on, we know, in the rudest

and most simple manner. When however, I consider the extreme poverty of the auriferous deposits, which by skilful and scientific management are profitably worked in Europe, and further take into account the very low price of labour in this country, I am firmly impressed with the conviction, looking at the subject in a practical point of view, that the application of the same means might in this country be made to produce an equally beneficial result. Although there is no reason to believe that our gold-washings generally, are rich enough to attract or to recompense individual enterprise, it is highly probable that in such a vast extent of country there may be some much richer than others. It is also probable, if not indeed certain, that there are many which might be made the means of affording a beneficial occupation to a large number of labourers, of contributing to the revenue of the state, and of forming in their aggregate results, a valuable addition to the metallic circulation of the country.

Should the experiment in question succeed, the benefits derivable from it, might, as I have shown, be very great; it would induce a more careful examination of numerous and widely spread auriferous deposits, a far more economical treatment of their produce, and very possibly the discovery of veins, or of limited tracts much richer than any hitherto made known by the casual discoveries of the natives. Even should the experiment fail, which is very unlikely, the expense might be limited from the first to a very moderate amount, while other indirect advantages, arising from an increased attention to the mineral capabilities of the country, might be confidently reckoned upon.

Supposing the auriferous deposits of India to attract the attention of Government, the plan which I should propose to follow, would be to obtain the services of some competent person, practically acquainted with the treatment of auriferous sands in Brazil, or with the reduction of gold ores, as practised in the Austrian mines. Perhaps a mining Engineer might be found, uniting both these qualifications. A careful examination of some of our auriferous sands, say those on the Malabar Coast, which evidently extend over several hundred square miles, would soon show where were the richest spots, and where the reduction works might be established with the greatest probability of success. The requisite apparatus need by no means be costly: it should embrace, besides minor articles commonly used in the washing and separation of gold, the amalgamation machinery, employed so successfully in the reduction of the poor quartzose ores of the Tyrol, and one or more furnaces to attempt the fusion of the auriferous sands, according to the plan successfully introduced in Russia about three years ago in the gold

works of the Ural mountains. The sands or other ores of gold might be bought of the natives, at a fixed valuation, according to the per centage of the precious metal which they were ultimately found to contain, a certain amount being paid to the contractors previous to their delivery. Were this species of industry to become thoroughly established in certain districts, as after a time it no doubt would do, the gold dust might form a useful medium of exchange, and be received by Government as " kist," which alone would give a powerful stimulus to production. Whether it would be most desirable for the mining Engineer appointed to the charge of the reduction works, to receive the auriferous sands from the gold washers in its first crude state, as originally collected by them, or whether it should first undergo some preliminary washing and concentration, is a consideration of some importance which could only be determined by experience.

In concluding this notice, I shall briefly draw attention to a subject which is too technical to be generally understood, although interesting in itself, and of primary importance as connected with the preceding suggestions. I allude to the actual produce, or *per centage* of gold, which can be profitably extracted from the ores or sands containing this metal, by the most economical and improved methods now practised in the gold mine districts of Europe and Brazil. From the data I shall now adduce it could easily be ascertained by a little chemical and mineralogical research, how far the auriferous deposits of India are likely to repay the improved system of realizing their produce, which I have now suggested. In fact from the very low price of labour in this country, there can be no doubt that ores of the same produce might be made to yield a much larger profit than in Europe, for in the *price* or *value* of the metals (gold and silver equally with any others), the actual labour expended in their production, forms by far the most considerable item.

It may be laid down as a general truth in mining, that, with very rare exceptions indeed, the ores of the precious metals are exceedingly poor, and that the metallic particles to be collected, bear but a very trivial proportion to the mass of worthless matter, throughout which nature has disseminated them. Thus in the silver mines both of Europe and America, the average produce of the bulk of ores extracted, does not exceed more than from 3 to 4 or 5 ounces in 100 pounds weight, or one pound of metal in 400 pounds of the ore. Yet silver ores of this low produce are in numerous instances profitably extracted from deep mines, where they have to be raised even three, four, or five hundred

yards to the surface, where powder is required for blasting the rock, water wheels, steam engines, or other expensive machinery for draining off the water, and where the price of labour is six, eight, or even ten times as great as it is in India. It is true that in these mines richer ores are also found, but they are in comparatively small proportion, fluctuating in their quantity and quality, and not to be depended on for profitable returns.

The value of gold being fifteen times greater than that of silver, it will readily be conceived that very minute quantities of this precious metal will pay for the expenses of extraction. In point of fact the poverty of some auriferous deposits is almost inconceivable, indeed it often happens that the particles of the precious metal are so very minute, and so sparingly scattered through the mass, that the naked eye is totally unable to detect them, and except by the careful mineralogist, the whole would be looked upon as mere worthless matter, and entirely rejected. Of this general poverty of gold ores, I shall now adduce a few striking examples, taken it will be observed from widely distant localities.

At Zelle in the Tyrol, a mineral district, situated a few leagues from Inspruck, the gold ores, or rather the auriferous mass extracted from the mines, yields on an average from five to seven ounces of the precious metal in 1,000 cwts. Now this amounts to only one pound of gold, in from two to three hundred thousand pounds of refuse, yet even from this exceedingly poor ore, the skill of the German mining Engineers, enables them to extract a small profit. The ore, I may further observe, is a hard quartz, very similar to that which occurs north of the Pennar River, in the Nellore district, and requires to be stamped or finely pulverized, before the gold can be extracted. At the mines of Kremnitz in Hungary, the average produce of the gold ores is only 7 to 8 ounces in the 1000 cwts, or 100,000 lbs, being thus very little higher than in the mines of Zelle.

Let us now turn to Brazil, a country well known for the large supply of gold which its mines annually furnish. The precious metal is here found in veins and worked by mining, but a vast quantity is also disseminated in very minute particles through the sands of certain auriferous districts, exactly as we have it in India. I have been informed by my friend Mr. Attwood, who has been resident for some years in the mineral districts of that country, that a cubic foot of this sand, which may be estimated as weighing about 1 cwt. is considered very profitable if it yields an *oitava*, or about one eighth of an ounce of gold, but that sands are worked which do not afford more than one-tenth of this produce.

In Carolina, in the United States, ores containing more than 1½ ounce per ton, or 1 ℔ of gold in 23,000 ℔s of ore, may for the most part be worked with profit, although disseminated in a hard matrix of quartz which requires to be pulverized by machinery. It is also particularly deserving of remark, that the price of labour in Carolina, like most other parts of the United States, is very high, being a dollar, or two rupees per day.

From a consideration of all the facts which have now been detailed, it appears to me that we may safely arrive at the following conclusions:—

1st.—That there are in India, immense and almost unexplored tracts of auriferous country.

2nd.—That these have here and there been worked by the natives, though doubtless in the most rude and imperfect manner.

3d.—That the reputed poverty of many, may be after all merely relative, when compared with other districts, which by better means are made to yield a profitable return.

4th.—That taking into account the occurrence of the precious metal in India, at the surface of the ground, and the very low price of labour in this country, compared with Europe or America, there is in all probability an ample field for increasing the revenue and benefitting the population, by the extensive introduction of gold washing and amalgamation, upon the same improved and economical system as is practised in the above quarters of the globe.

I shall mention in conclusion, that, by means very similar to what I have now suggested, Russia has within the last few years laid open a new and important source of wealth to the empire. At the commencement of the present century, in fact till within the last few years, the mineral district of the Ural mountains was almost unknown, and only productive to a small extent. Careful examination has, however, shown, that auriferous sands exist in great abundance, and that platinum occurs more sparingly, and considerable attention has of late years been given to the skilful development of these mineral resources.

The results of these exertions have been most encouraging—this district now yields annually more than 12,000 lbs. of gold, and a small proportion of platinum, producing altogether the annual sum of £800,000 sterling to the government. A large proportion of the gold of the Ural is produced from exceedingly poor auriferous sands, like those of India; and it has lately been found practicable to separate the gold by *fusion*, more cheaply than by the ordinary process of amalgamation by quicksilver. The economy of this expensive article in the reduction of the poorer ores of gold, is of course an important consideration.

With reference to this last operation—the extraction of the precious metal from its extraneous concomitants—it is deserving of remark, that a very interesting discovery has been made within the last year or two by M. Becquerel, the distinguished French chemist. It has been discovered by this philosopher that the electro-chemical agency may be employed in the reduction of the ores of the precious metals, as a substitute for the ordinary process of fusion or amalgamation; and it is highly probable that by this important invention this operation may shortly be economized, to an extent hitherto unattainable. In this case it will allow of the profitable working of auriferous sands, and ores, even poorer than any which have been described in this paper. It is not improbable, therefore, that this refined and important discovery, may constitute an entirely new era in the history and production of the precious metals.

IV.—*Observations on the Fossiliferous beds near Pondicherry, and in the district of South Arcot.—By* C. T. Kaye, Esq. *Madras Civil Service.*

The existence of a bed of fossiliferous limestone in the neghbourhood of Pondicherry has long been pretty generally known to those who take an interest in such subjects, and some attention was recently attracted to it by several communications in the *Spectator* Newspaper. An observant person, indeed, can hardly fail of being struck with the nature of the stones which form the paving of some of the streets and the steps of many of the houses in Pondicherry, and which are replete, not only with the fragments of innumerable shells, but with many ostreas and other bivalves almost as entire as if they still reposed in their proper element. The silicified wood at Trivacary is also well known to the public from the beautiful polish which it receives, and from its adaptation to table and other ornaments. To the geologist it is interesting from the vast size of the petrified trees (one of which is nearly 100 feet long), from their great number, and from the perfect state in which these organic remains of other worlds are preserved.

It had long been a desideratum to collect data on which the era and nature of the formations which contain the fossils might be decided, and I accordingly took an opportunity of leisure in October last, to proceed to the spot with Mr. Cunliffe of the Civil Service. The time which we were enabled to devote to the investigation was unfortunately short,

and it might certainly have been committed to more scientific and experienced hands. I trust, however, that the facts which we were fortunate enough to collect were not altogether unimportant, and that, imperfect as our researches must necessarily have been, they may pave the way to more interesting discoveries.

Before proceeding further, I may as well mention, that, although the geology of India has generally been considered uninteresting on account of the absence of fossiliferous strata, Pondicherry is not the only locality in the south of the peninsula, where fossils are to be met with in abundance. In the inland district of Trichinopoly marine shells are also found imbedded in limestone, and the kindness of Mr. Onslow has put me in possession of several interesting specimens, of which notice will be taken hereafter.

The village of Seedrapett, the site of the shell limestone which is the subject of the present notice, is seven miles west of Pondicherry, and Trivacary is about eight miles to the west of Seedrapett. The form of the country may be characterized as an undulating plain: the limestone formation is flanked both on the east and west by one of the red sandy soil, which on the one side forms the low mounds of Trivacary, and on the other the "Red Hills" of Pondicherry, the latter being perhaps a continuation of the same formation which contains the silicified wood. If this be the case, it is evident that the limestone rests upon a basin or depression of the red sand, but owing to the absence of sections, and the imperfect means we had of ascertaining the position of the strata, this fact is by no means laid down as established, but is merely suggested as a point for future investigation.

The petrifactions of Trivacary have been often described, especially of late, it is only necessary therefore to state that they consist of numerous silicified trees, some of them of vast dimensions, resting more or less buried on low bare hills of a friable red sandstone. The hills are grouped in a circular form, and the petrifactions in many instances retain a perfect resemblance to the trunks of fallen trees. The red hills are bounded by others of a dark granite: the line of demarcation being very distinct. The trees, however, are not found reposing on the hillocks at Trivacary alone, but we observed them at a distance of at least three miles from that place, imbedded in the red sand, on the road to Seedrapett. We were totally unable to discover any other fossil, or any indication of such a thing, in the red soil which so abounds with the silicified wood.

There is a gradual descent from Trivacary towards Seedrapett, and the limestone commences immediately on the boundaries of the red soil:

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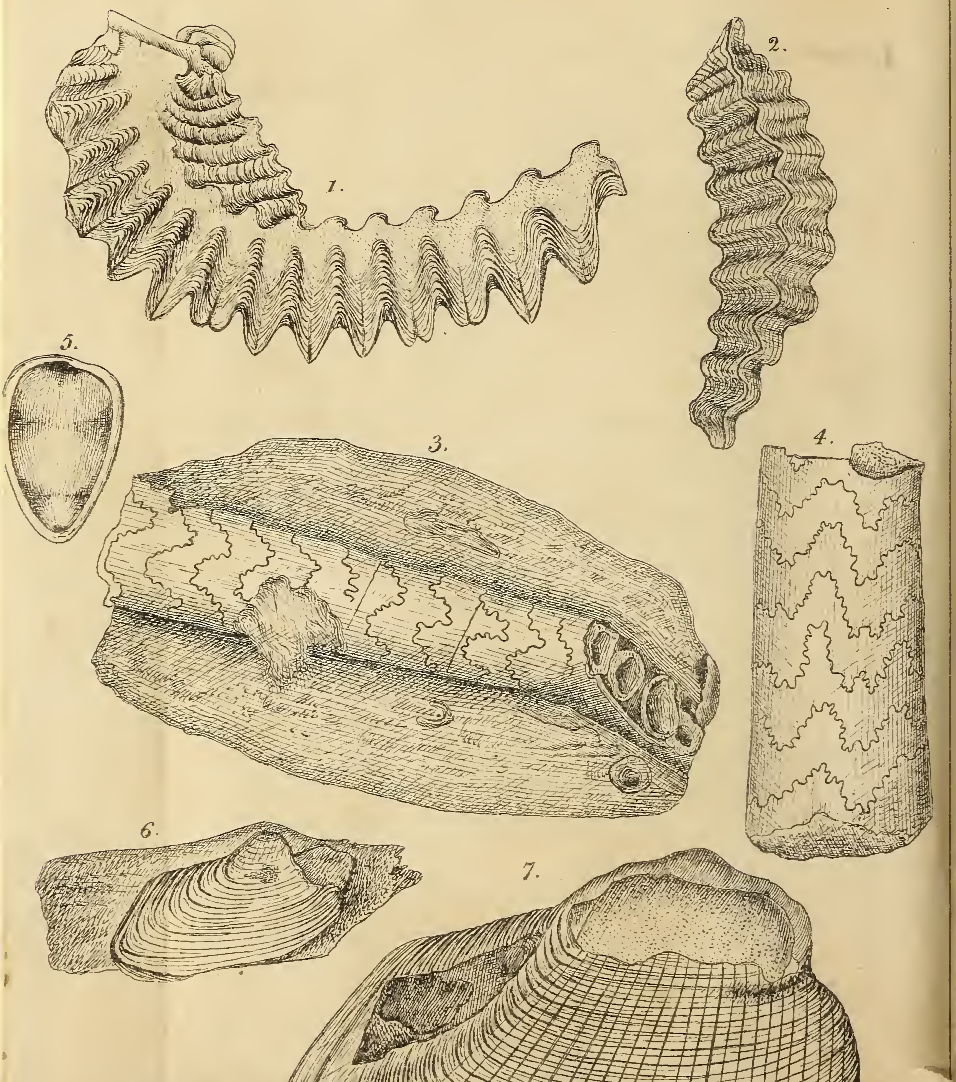

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it presents, as has been already stated, an undulating wavy surface, and the stone is found immediately below the turf, and sometimes even appears above it: it is quite hard, and is quarried in large blocks, though to no great depth, for the purposes before mentioned. It is almost every where replete with shells or other organic remains, which are in general so firmly imbedded in the hard stone that it is impossible to detach them:—the geologist, therefore, who would study with accuracy the nature of this deposit, should endeavour to reside for some period on the spot, many of the shells which are most perfect in the stone, not having yet been discovered in a separate state. In one situation, however, there are several small mounds of a whitish limestone, almost resembling chalk, where the surface having been abraded and decomposed by water, the shells which it contained have been separated, and lie scattered on the surface of the soil, among the debris of the containing rock: it was in this spot that most of the specimens here noticed were collected. I will now proceed to describe them in the order in which they appear in the Plates.

Pl. I. Nos. 1 and 2—*Ostrea carinata*—The identity of this shell with that figured by Lyell and other authors among the fossils of the European chalk cannot be doubted: they are very numerous at Seedrapett, and are found both in a separate state and imbedded in the rock, sometimes very perfect. No. 1 is slightly fractured at the point, but the linear marking, and even the sharp angles of the ribbing on the sides, are beautifully preserved, and the inner surface retains much of its polished enamel. No. 2 is a perfect specimen of the two valves adhering firmly together.

Nos. 3 and 4 are *Baculites*. This shell is called by Dr. Buckland a straight ammonite, and the same authority states that it is " found in the cretaceous formation alone." We collected many fragments of this shell on the surface of the soil, varying from three inches to half an inch in length: the most perfect specimen being imbedded in a rolled piece of limestone (No. 3), and owing to a longitudinal fracture displaying four of its chambers. All the specimens display the foliated markings at the junction of the walls of the chamber with the external shell: they are of a yellowish or reddish brown colour, and the interior is generally filled with beautifully crystallized calcareous spar. No. 5 is the transverse section of a baculite.

Nos. 6, 7, 8 are bivalve shells, probably referrible to the genus Cardium; they are represented about the natural size; 6 and 7 retain the shell itself and appear almost recent, but the interior of No. 7 is filled with

the limestone and fragments of shells cemented together sufficiently hard to take a polish. In No. 8 the shell itself has disappeared and left merely a cast in whitish limestone

Plate II. Nos. 1 and 2 are *Echini*, of the order *Spatangus*, common in the chalk of England. No. 2 is a small but perfect specimen. No. 1 is a portion of the external shell flattened out on the stone.

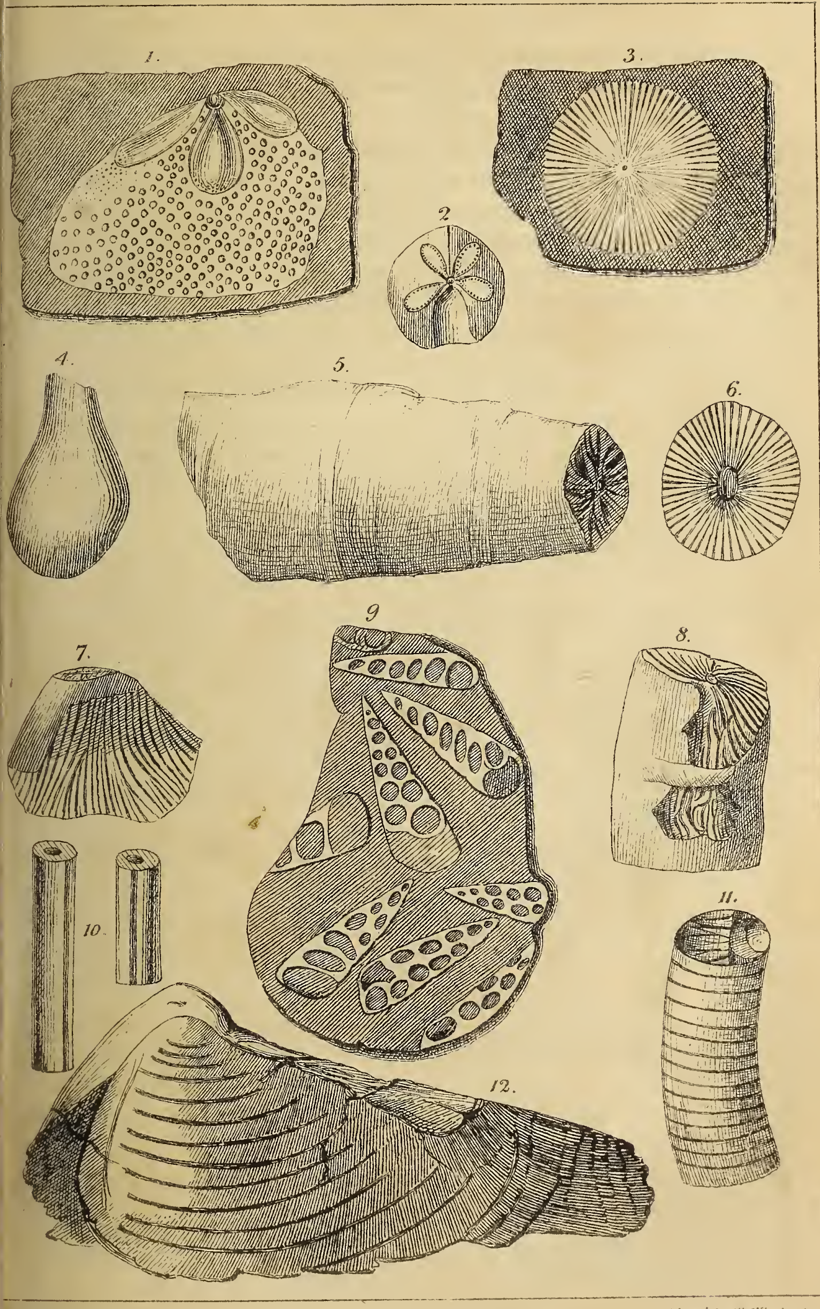
No. 3.—This is apparently the apex of a *Turbinolia*: it is not unfrequent in the limestone, and was sometimes found detached, in which case it precisely resembles the drawings of the *Turbinolia* given by Dr. Mantell, in his Geology of the South-east of Sussex, but is apparently of a larger species.

Nos. 4, 5, 6, 7, 8 are fragments of a zoophyte or coral with a pyriform body or termination, which is always found detached (No. 4); other fragments are cylindrical. This zoophyte seems to have consisted of numerous small lamellæ, converging *towards* the centre: but there was probably a cavity *in* the centre, which is now filled up with the chalky substance, as the lamellæ do not unite at the axis. No 6 shows the radiated appearance presented by the transverse section of a cylindrical joint or fragment, and 7 and 8 display the internal structure where it is laid bare by the decomposition of the external covering. These fragments are probably the joints of the stem or branches of the zoophyte, which may possibly therefore, have been the *Apiocrinites ellipticus*, but until more perfect specimens are found it cannot be named with any degree of certainty. The component matter of this fossil is carbonate of lime, and it effervesces freely with acid. They are found in great numbers close to the village of Seedrapett. We collected upwards of an hundred in about half an hour, and one of the best specimens I took out of the wall of a mud house.

No. 9 is a small mass of limestone, displaying on both sides beautiful sections of a multilocular shell, which Mr. Burr informs me is a *Turrilite*.

No. 10. A great number of small cylindrical bodies of this description were found, the longest perhaps 1½ inch in length, and about the thickness of a tobacco-pipe: they all have a longitudinal groove or sulcus, whence it may be inferred that they are a species of *Belemnite*, perhaps *B. minimus*; but it must be mentioned that, among the hundreds that were collected, and the still more numerous specimens that were thrown aside, not one was found which came to a point. Further research may, perhaps, supply this deficiency.

No. 11. Several casts of a slightly curved chambered shell, with annular markings, probably referrible to order of *Hamite* were found.



ansfer by J. Dumphy. Printed by W. Winchester.

The drawing represents the chamber as seen in the section, but the radiated marking is probably owing to crystallization.

No. 12 is a cast in limestone of a bivalve shell.

It is no easy thing to name fossils even to those who are most accustomed to geological researches, this department forming in general a separate branch of the science: many of the fossils, however, described in the above lines are of so marked a character, that in those instances where we have ventured to name them with any degree of certainty, we can hardly have been mistaken. I have not neglected either to consult those who were best able to give an opinion on the subject, and have also carefully compared the specimens with the best drawings and authorities I could meet with. To Mr. Frederick Burr, I am particularly indebted for the valuable assistance and information he has afforded me. If we do not err therefore very widely from the mark, we have, even on the information already obtained, very good *primâ facie* evidence that the Pondicherry beds are the equivalents of the upper secondary formations of Europe, and the fossils point especially to those of the chalk and greensand.

It is a well known fact that, during the formation of the cretaceous beds in England, a great quantity of silex held in solution by water must have been poured out; which, by the process of chemical affinity having collected around various organic nuclei such as corals, sponges and other zoophytes, has formed continuous and extensive layers of flint, interstratified with the chalk, almost every nodule of which contains and derives its shape from the enclosed remains of some organized body in a state of complete petrifaction. We observed no vestige of flints in the limestone at Seedrapett, and all the fossils collected there consist of carbonate of lime, and effervesce freely with acid; but the vast quantity of silicified wood, in the neighbouring formation of red sand, seems to point to some phenomenon similar to what must have existed during the deposition of the cretaceous beds of Europe.*

Lieut. Newbold, in the last number of the Journal, suggested that the fossiliferous beds of Pondicherry probably extended into the Verdachellum talook of South Arcot. I have made enquiries but have not yet obtained any evidence of this fact. Another interesting question, how-

* "Flints so commonly enclose the remains of sponges, alcyonia and other zoophytes, that some geologists are of opinion that the nucleus of every nodule was originally an organic body: that this has been the case in most instances is very evident: and in Sussex there are but few flints that do not possess traces of zoophytical organization."
Mantell's Geology of Sussex, 144.

ever, now suggests itself, viz, is the shell limestone at Seedrapett analogous and contemporaneous with that already mentioned as containing fossils in the Trichinopoly district? Sufficient data have not yet been collected to enable one to give a positive reply to this enquiry. The specimens which I have received from Trichinopoly consist of masses of limestone, very similar in character to that of Seedrapett, and containing innumerable small shells cemented together in the hard rock. Shells are, however, found detached from the stone, in general I should say in a more perfect state than those at Seedrapett.

Pl. III. No. 1, is a large bivalve from Trichinopoly: of which the shell is entire, with the exception of being chipped at the edges: it is filled with limestone.

Nos. 2 and 3 are intended to shew the nature of the shells contained in two small masses of the stone: the most perfect shells have been chosen for representation, but it was found impossible to figure the innumerable small shells and fragments of which the mass almost entirely consists. The shells in No. 2 are small turrilites, evidently of the same species as those represented in Pl. II. No. 9. Several specimens from the same locality, in Dr. Cole's possession, appear to me also to be turrilites, a fact which leads us to infer some analogy between the two formations, which further research will probably tend to demonstrate.

An interesting fossil from Trichinopoly in my possession is a piece of calcareous fossil wood, containing a number of petrified Teredines in crystallized carbonate of lime.

There can be no doubt that our knowledge of these beds is still very imperfect, and it may be supposed that it would have been better to have deferred the present notice until more accurate information should be obtained; but a temporary residence in Madras gave me an opportunity of consulting works to which I might not otherwise have had access, and also afforded facilities for getting up the drawings, &c. connected with the publication, which I was the more unwilling to neglect, as they might not speedily recur.

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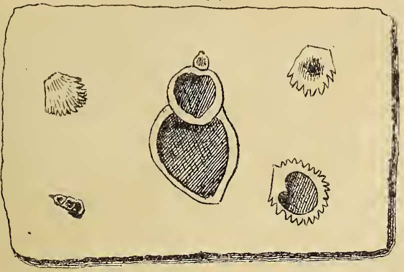

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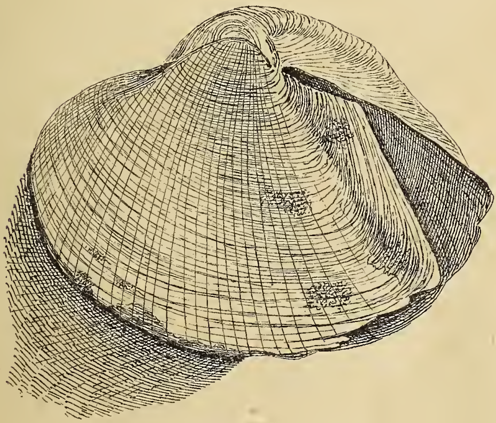

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V.—*Remarks on the Fruit of the Natural Order Cucurbitaceæ.—By* Robert Wight, M. D., F. L. S. &c.

The order *Cucurbitaceæ*, is perhaps one of the most curious and inexplicable in the system of plants, and though at different times much studied by several eminent botanists, is still imperfectly understood; at least if we may judge from the fact, that no two writers on the distribution of plants according to their natural affinities seem to agree as to what families are its nearest allies. It is not now my intention to examine this question, for which, indeed, I have not at present leisure, even supposing I possessed the requisite materials, which I do not, but merely to offer a few observations on the general character of the family and fruit, introductory to a conspectus of the genera of the order, with which Dr. Arnott kindly favoured me, and at the same time permitted me to place on the pages of the Society's Journal, should I deem that desirable. Deeming the conspectus really a most desirable addition to our Indian botanical literature, I have much pleasure in submitting it for that purpose, in the hope that the Society may be of the same opinion.

The *Cucurbitaceæ* are a tribe of plants so very unlike the rest of the vegetable kingdom, that I think I may safely say no one having the slightest knowledge of family likeness among plants, could ever mistake so far as to refer one of them to any other family. Though thus isolated from all around, and without a single near relation with whom they can be justly compared or confounded, they yet stretch their more remote affinities on all sides; hence the difficulties which systematic writers find in decisively referring them to any one place, more than another, in the series of orders. Nearly all however, now agree in placing them among orders having parietal placentæ, that is, among plants the ovary of which is one-celled.

To any one who will take the trouble to look attentively at a slice of a young cucumber this must appear strange, but is yet not the less true. In one of the latest and the best introductions to botany in the English language, Dr. Lindley's, a peponida, the peculiar fruit of the order, is thus defined :—" One-celled, many-seeded, inferior, indehiscent, fleshy; the seeds attached to parietal pulpy placentæ. This fruit has its cavity frequently filled at maturity with pulp, in which the seeds are imbedded; their point of attachment is, however, never lost. The cavity is also occasionally divided by projections of the placentæ into spurious cells, which has given rise to the belief that in *Pepo Macrocarpus* there is a central cell, which is not only untrue but impossible."

Dr. Arnott in the article Botany, Encyclop. Brit. Ed. 7, gives a different account of it, but still, it appears to me, far from a correct one, namely :—" A *pepo* or *peponida* is a fleshy inferior fruit, either indehiscent or bursting irregularly, and consisting of about three carpels, each of which is divided into two cells by its placentiferous margin, being so introflexed as to reach the dorsal suture. The sides of the carpel, and even sometimes the introflexed portion, usually become extremely thick and fleshy, forming the great mass of the ripe fruit, so that by losing the general character of dissepiments, they might almost be said to disappear, and thus at first sight a pepo would be said to be, and has been so described, a 1-celled, fleshy, indehiscent fruit, with parietal placentas, that send out sometimes false dissepiments towards the axis, as the cucumber and gourd."

This view, therefore, is essentially different from Dr. Lindley's, for, according to Arnott the placentæ are virtually central, not parietal. The only difference between a pepo and an apple being, according to him, that the placentiferous margins of the carpellary leaf are introflexed, and extend outwards nearly to the parietes of the fruit, in place of remaining in the axis. Lindley on the other hand views a pepo simply as a one-celled fruit with parietal placentæ, the cavity being occasionally divided into spurious cells by projections of the placentæ. Neither are altogether consonant with appearances, though that of Arnott appears the most so; but both, in common with all others that have yet been promulgated, are incorrect both as to theory and fact.

While our ideas of the structure of the most essential organ of the plant, with reference to natural affinities, are thus vague, can it be matter of surprise that we are unable to trace its relations, and determine its affinities in the system of plants ?

What then is a peponida ? I have said above that it is neither a one-celled fruit with parietal placentas, nor a three-celled one with introflexed central placentas. But before I can say what it is, and point out the difference between it and a fruit of the usual construction, it is necessary to state what the usual structure is. This I shall do by means of a short extract from Lindley's Key to Structural Botany.

354. " A Carpel is formed by a folded leaf, the upper surface of which is turned inwards, the lower outwards ; and the margins of which develope one or a greater number of buds, which are the ovules.

355. When the carpels are stalked, they are said to be seated upon a *thecaphore*, or *gynophore*; *Ex.* Cleome, Passiflora. Their stalk is analogous to the petiole of a leaf.

355. *a.* When the carpels are all distinct, or are separable with facility, they are *apocarpous ;* when they all grow into a solid body, which cannot be separated into its constituent parts, they are *syncarpous.*

356. The ovary is the lamina of the leaf.

357. The style is an elongation of the midrib (174)

358. The stigma is the denuded, secreting, humid apex of the midrib.

359. Where the margins of the folded leaf, out of which the carpel is formed, meet and unite, a copious development of cellular tissue takes place, forming what is called the *placenta.*

360. Every placenta is therefore composed of two parts, one of which belongs to one margin of the carpel, and one to the other.

361. As the carpels are modified leaves, they necessarily obey the laws of arrangement of leaves, and are therefore developed round a common axis.

362. And as they are leaves folded inwards, their margins are necessarily turned towards the axis. The placentæ, therefore, being formed by the union of those margins, will be invariably next the axis."

From this we learn, in few words, that the carpellary leaf is always so folded that its midrib is towards the circumference, or forms the dorsum of the cell or carpel, while the placentiferous margins are placed in the axis; that the difference between a one-celled and many-celled fruit, merely consists in the placentiferous margins of the carpellary leaves of the former not extending inwards to the axis, but stopping in the circumference and bearing their ovules attached to the walls of the cell—hence *parietal.* This position of the carpellary leaf is so constant, that the possibility of an inversion of this order of things in a pepo seems never to have entered into the calculations of any one of the numerous botanists who have given their attention to the investigation of the structure of this curious fruit; and yet such is simply the case. In a pepo the normal position of the midrib of the carpellary leaf is reversed, that is, is placed in the axis, and the placentiferous margins towards the circumference. That such is actually the case requires no argument to prove; we have only to cut the ovary of any true cucurbitaceous plant to be made sensible, at a glance, that it is so: though I confess that in none have I seen it so clearly made out as in *Coccinia Indica*, owing to the carpels of that species remaining distinct, merely held together, not as usual by cohesion between the respective carpels, but by the tube of the calyx in which they are enclosed. Did I wish to illustrate the theory by means of a diagram, I could not devise one more perfect than a simple section of the ovary of that plant, merely extending the natural divisions, by dividing the calyx, so as to allow each of the carpels to

be slightly separated in the representation, to facilitate the demonstration. This, however, is I think even unnecessary, for with the clue to the true structure, which this species furnishes, there can no longer be any difficulty in understanding it from the examination of any genuine species of the order.*

What effect this new exposition of the structure of the ovarium may have on the determination of the affinities of this order, I am, up to the present time, quite unprepared to say: but of this I feel certain, that, in so far as structure is concerned, they are as far removed from all their now reputed allies, as their peculiar habit removes them from all the parietose families, except *Passifloræ*, among which Bartling, Endlicher and Lindley have placed them. This very unusual structure, in short, marks them as a peculiar order, the affinities of which have still to be sought for.

I am equally unprepared to say to what extent this unlooked-for structure may influence our views in regard to other anomalous orders, especially those with solitary carpels: since, having established the fact that the usual structure may be inverted, it will naturally lead to new investigations, which may prove, that the solitary carpels of *Leguminosæ* are not, as now supposed, necessarily the result of constant abortion of one of two carpella, but may be explained on some other theory more consonant with the, almost invariably observed, structure in that large and interesting order; which, like *Cucurbitaceæ*, stands an isolated family in the system of plants, through this one remarkable peculiarity,—a peculiarity so constant, in this tribe, that it goes far to prove the existence of that botanical nonentity, a terminal leaf. But, being unprepared to offer any matured opinions on these points, I forbear further speculation, and shall at once proceed with the conspectus; trusting, however, ere long, to be able to re-enter more at large on the consideration of this interesting enquiry.

The subjoined remarks, I copy from the article *Cucurbitaceæ* in my forthcoming Number of the Illustrations of Indian Botany.

" The following explanatory extracts from the letter which accompanied the Conspectus, may not inappropriately be introduced.

" ' I have lately been revising our East Indian *Cucurbitaceæ*, in consequence of Schrader's paper in the Linnæa, vol. 12. At first I was inclined to consider it worse than useless to subdivide old genera, especi-

* After this paper was in the printer's hands it was suggested that some illustrations were desirable to render the verbal description more easily understood. The accompanying figures representing the three different forms of ovaries—1-celled with parietal placentæ; several celled with central placentæ; and a Peponida; were therefore prepared,

ally *Bryonia*, as he has done ; but when I came to consider his sectional characters, and that the form and position of the stamens and anthers and stigma and fruit are, really, the only characters hitherto employed for genera by other botanists ; and that all Schrader has done, is to keep only those species in their old genera that agree with the character and turning out, and making new genera of those that do not, then I felt inclined to go great lengths towards adopting his views. I intend here to give you a Conspectus, or abridged generic characters, which I have drawn up, not only for the Indian, but also for the whole world, which I shall not object to your publishing as " abridged characters of the genera of the tribe *Cucurbiteæ* of Schrader.'

" At the conclusion of the conspectus he continues,—' These seem to be all the genera known that truly belong to *Cucurbiteæ*, they have all unisexual flowers. *Gronovia* has them bisexual, but is otherwise very closely allied. *Allasia* cannot be of this order, unless we suppose the description quite erroneous ; and if so, Loureiro may have had before him, in part at least, the *Telfairia pedata ; Myrianthus* cannot belong to *Cucurbitaceæ*.

" ' *Thladianthus Runge* is imperfectly described as to the stamens, but may perhaps form a 7th tribe.

" ' I have laboured under great difficulty in making out these characters, partly because the published descriptions were very imperfect, partly because I had not several of the genera, and partly, from the extreme difficulty of examining the anthers after being dried and pressed. I would therefore suggest to you and other Indian botanists, to re-examine all the Indian ones on living plants, and have drawings made, paying particular attention to the representation of the anthers.

" ' At first you may, as I did, confuse section 7 with section 9, but if you will compare the flower of *Citrullies*, *Momordica* or *Lagenarea* with *Cucurbita* or *Coccinia*, you will readily see the difference. In section 7, the connectivum is lobed, and the anther cells are placed along the edge of the lobes—in sections 8 and 9 the connectivum is not itself lobed, but the anther cell is bent,' (it winds upwards and downwards along the back of the connectivum).

" Warned by the concluding paragraph of the difficulty attending the description of these plants from dried specimens, I took occasion, as opportunity offered, to compare some of the sectional characters with recent specimens, and feel disposed to think the sections too numerous, and not sufficiently distinguished. I have not yet succeeded in comparing the whole, but would suggest the following alterations, which I think would improve the arrangement.

" Section 6 might with advantage be suppressed, and its only genus referred to section 5. Sections 7 and 9 would be better united, the anthers being the same in both; transferring, however, *Cucurbita* to section 8, on account of the anthers, which are similar to those of *Trichosanthes*, making the insertion of the filaments a matter of secondary consideration, a generic not a sectional distinction.

" The difference between sections 7 and 8 would then be—not that in the former the anther is lobed and in the other entire, but that in section 7 the back is traversed by an elevated gyrose ridge, on the top of which the long gyrose anther is placed, while in section 8 there is no such elevation, the anther cell being sunk into the substance of the connectivum, not elevated on a ridge with a deep furrow between each bend. To this may be added that the connectiva in section 8 is elongated; hence, from the union of the three, a cylinder results, while in the other their union produces a sort of capitulum.

" *Bryonia Garcini*, doubtfully referred to *Bryonia*, is a new species of *Pylogyne : Bryonia leiosperma*, I find, from the examination of dried specimens, is a second species of *Mukia*, with which it agrees well in habit.

" Notwithstanding these differences of opinion, it is not my intention to alter the conspectus, but print it simply as it reached me, the few additions I have to make, being included within brackets—thus [ ]. Before proceeding further it may be well to explain what is meant by the term tri-adelphous, as applied to this family, which is of such frequent occurrence in the following characters. The normal structure of *Cucurbitaceæ* is to have five stamens, in place of which we usually find only three; but when these are carefully examined it appears that two of them are twice the size of the third, and are actually made up of two united: each set is then called an adelphi or brotherhood, and the three together tri-adelphous This structure is readily seen in the *Pekunkei* (*Cucumis acutangulus*, Ainsley) where the anthers do not cohere. In those where they do cohere it is not so clearly seen, as they then require to be separated artificially before it can be made out.

" In some genera the anthers are described as being one or two-celled; these characters require to be used with caution, as being generally of very difficult application in practice. Theoretically every anther is two-celled, and here in examining a number of instances with particular care, under a high magnifier, I have found most of them actually two-celled, though on less careful examination they appeared only one-celled. If such is the case when examined with fresh specimens, how much more liable to error must we be when working with dried ones.

CONSPECTUS OR ABRIDGED CHARACTERS OF THE GENERA OF THE TRIBE CUCURBITEÆ* OF SCHRADER.

§ 1.—*Filaments 5, inserted on the throat of the corolla; anthers distinct or 3-adelphous, anticous, straight; fruit baccate, few seeded.*

1 Coniandra (Schrad.). Corolla 5-partite: connectiva conniving, oblong, conical: fruit beaked. *South Africa.*

2 Cyrtonema (Schrad.). Limb of corolla 5-partite: filaments 5, incurved, connectiva incrassated 3-adelphous; anthers fixed laterally under the apex. *South Africa.*

§ 2.—*Filaments di or tri-adelphous, inserted on the tube of the corolla; anthers lateral, straight, 2-3-adelphous.*

3 Sicydium (Schlecht). Corolla 5-petaled, petals undivided: filaments 3-adelphous, dilated and incurved at the apex; anthers without a beak. *Mexico.*

4 Bryonopsis (Arn.). Corolla 5-partite, lobes obovate, entire, undulated: filaments 3-adelphous, inserted on the throat, straight; anthers pointless: stigma fringed: berry few seeded. *East Indies—Courtal'um.*

5 Achmandra (Arn.). Lobes of the corolla undivided: filaments tri-adelphous very short; anthers anticous, inserted along the margins of the connectivum, linear oblong; connectivum prolonged into a short beak beyond the anther: fruit baccate (always?) beaked. *East Indies. Bryonia epigæa, rostrata, deltoidea, and an undescribed species from Malabar.*

Obs.—Perhaps this and the two last genera might be joined to Melothria.

6 Melothria (Linn.). Lobes of the corolla undivided, denticulated: filaments 3-adelphous; connectivum pointless: fruit baccate, not beaked. *America.*

Obs.—Schrader notices an East Indian one, but that may perhaps be an *Achmandra.*

7 Ceratosanthes (Schrad.). Lobes of the corolla linear bifid: filaments 3-adelphous. *America.*

8 Anguria (Linn.). Lobes of the corolla entire: stamens diadelphous: fruit somewhat 4-angled. *America.*

§ 3.—*Filaments 3-adelphous inserted on the top of the tube, anthers all*

* This tribe contains all the East Indian genera except *Zanonia*—Schrader refers *Erythropalum* of Blume to Cucurbiteæ but that genus is very closely allied to *Mackaya* (Arnott in Jardine's Mag. of Zool. and Bot. vol. 2) and does not belong to the order.

cohering by means of their connectiva, and applied at the back along the margins of the connectiva sigmoid. (?) two-celled.

9 Schizostigma (Arn.). Style simple, stigma, peltate, fleshy, cleft into 10-12 radiating linear lobes. *Andes of Mendosa.* (*Cucurbita asperata.* Gill.)

§ 4.—*Filaments distinct or tri-adelphous, inserted on the throat of the corolla, anthers* 6 *or* 3-*adelphous, gyrose, anticous.*

10 Sphenanthe (Schrad.). *Mexico.*

§ 5.—*Filaments tri-adelphous, inserted at the base of the corolla, anthers lateral, straight,* 3-*adelphous.*

11 Pilogyne (Schrad.). Calyx campanulate; segments of the corolla patent, much longer than the calyx: anthers one-celled: style entire; stigma 1, pileate: fruit baccate, few seeded, obtuse. *South Africa.* [*East Indies—Bryonia Garcini ?*]

12 Zehneria (Endl. ?). Lobes of the corolla quite entire: style trifid; stigmas 3, flabelliform, quite entire: fruit baccate, few seeded, blunt. *South Africa, East Indies* and ? *Norfolk Island.—Bryonia Mysorenses. B. Hookeriana.*

Perhaps this is only a subgenus of *Pilogyne.*

13 Karivia (Arn.). Calyx urceolate, corolla scarcely exserted, lobes minute, quite entire; anthers two-celled; style entire; stigma pileate, 3-fid: fruit a peponida, many seeded, blunt or with a short thick beak. *East Indies, Bryonia umbellata. B. amplexicaulis.*

14 Rhynchocarpa (Schrad.). Lobes of the corolla denticulate, ciliated; style trifid; stigmas 3, jagged and toothed: fruit with a long slender beak. *Guinea.*

§ 6.—*Filaments tri-adelphous, inserted at the base of the corolla, anthers all cohering, posticous, linear, straight.*

15 Mukia (Arn.). Style entire, stigmas 3, more or less cohering, erect. Anthers distinct, one-celled, lateral; [connectivum prolonged, forming a projecting point: a globose abortive ovary in the bottom of the calyx.] *East Indies—Bryonia scabrella.* [*B. leiosperma.*]

§ 7—*Filaments* 5, *or tri-adelphous, inserted at the base of the corolla; connectiva toothed or lobed, anthers applied at the back along the margins of the connectivum, and therefore flexuose, gyrose, or anfractuose.*

16 Bryonia (Linn.). Corolla 5-cleft: anthers tri-adelphous, one celled: style trifid; stigmas subreniform or bifid: fruit ovoid or globose, baccate; few seeded. *Europe* and *East Indies—B. laciniosa*, India. *B. alba. B. dioica*, Europe. Perhaps also *B. Garcini* and *leiosperma*, but of these I have no male flowers by me to examine [*B. Garcini.* Stamens tri-adelphous one-celled: cells linear, marginal, not sigmoid, anticous: style one,

stigma dilated, peltate: ovary few seeded; pepo inverse reniform, 2 seeded. This is probably a new genus, but if not seems to belong to *Pilogyne* rather than any other here. It cannot possibly belong to *Bryonia.*]

In the European plants, the type of the genus, there are 2 ovules in each of the 3 cells of the ovary—nearly all Blume's species belong to other genera.

17 Citrullus (Schrad.). Corolla persistent, 5 parted, subrotate: anthers tri-adelphous, bilocular: style 3 fid; stigma obcordate, convex: fruit a fleshy or dry and fibrous, many seeded peponida. *Africa, East Indies. Cucurbita citrullus* and *Cucumis colocynthis.*

18 Ecbaliam (Rich). Corolla 5 cleft: anthers tri-adelphous: ovules in two rows in each cell; stigmas three, two horned: fruit an elastically and irregularly bursting peponida. *Europe—Momordica elaterium.*

19 Momordica (Linn.). Petals 5, adnate to the base of the calyx, deciduous: anthers all cohering: ovules in a single* row in each cell; stigma two lobed; fruit a capsular, elastically bursting, 3 valved peponida. *E. Indies, South Africa* and *America.*

[*This though practically correct is not theoretically so, the carpellary structure being the same here as in others; each margin has its placenta and ovules: and though at any one section only one row appears, we do not find the ovules always attached to the same line of placenta on slicing the ovary successively from end to end, but sometimes on the one, sometimes on the other side of the cell; such at least I find it in *Momordica Charantia.*]

To this genus seems to belong, *Muricia*, Loureiro and *Neurospermum*, Raf.

20 Luffa (Cav.). Petals 5, inserted in the base of the calyx, deciduous: anthers all distinct or di-triadelphous: style 3 fid; stigma reniform or bipartite: fruit a peponida, at length dry and internally fibrous, usually opening by a terminal lid, rarely indehiscent. *East Indies* and *Arabia.* There are 3 sections of this genus.

1st. Stamens distinct, *Luffa pentandra*, *acutangula*, and *Kleinii.*

2d. Stamens 3-adelphous. *L. amara*, Roxb. and nearly all the species of *Turia*, Forsk.

3d. Stamens di-adelphous—*L. tuberosa*, Roxb.

21 Benincassa (Sav.). Corolla (yellow), five parted, patent: anthers 3-adelphous: style undivided, very short; stigma large, thick, irregularly lobed and plaited: peponida, fleshy indehiscent. *Asia.*

22 Lagenaria (Ser.). Corolla (white) five petaled: anthers 3-adelphous: style almost none; stigmas 3, thick and 2-lobed: peponida fleshy and indehiscent. *India, South Africa;*

§ 8.—*Filaments, 3-adelphous, inserted on the tube of the corolla; connectiva entire, anthers 3-or mon-adelphous, posticous, linear, bent upwards and downwards : calyx long, tubular.*

23 Trichosanthes (Linn.). Segments of the corolla lacerated and fringed : anthers 3-adelphous? or all united : style trifid; stigmas oblong, subulate : fruit a peponida, many seeded. *E. Indies.*

[In all the species I have had an opportunity of carefully examining, the anthers are monadelphous or united. The style is not trifid, nor properly speaking the stigmas subulate, as they cohere nearly to the apex by their central face, though the stigmatic surface extends for some distance outwardly, and presents a somewhat subulate outline.]

I reunite *Involucrarea* to this as a mere section depending on the bracteas, the character taken from the anther not holding good, at least *T. Cucumerina* has frequently the anthers all united, and I suspect also *T. Anguina*; perhaps they only become tri-adelphous after fecundating.

[In *T. Anguina* they are never tri-adelphous, the anthers cohere to the last as represented in the accompanying figure. This last species with *T. globosa*, and *trifoliata*, Blume, and *Involucrarea*, Serange (*T. Wallichana*) form a very characteristic section, perhaps a subgenus, distinguished by their curiously bracteated male flowers]. R. W.

24 Gymnopetalum (Arn.). Calyx constricted at the mouth : corolla (yellow) 5 parted; segments quite entire : anthers all closely cohering : fruit baccate, ovate, beaked, few seeded: seeds large, roundish, with a blunt margin *E. Indies.* There are two species—

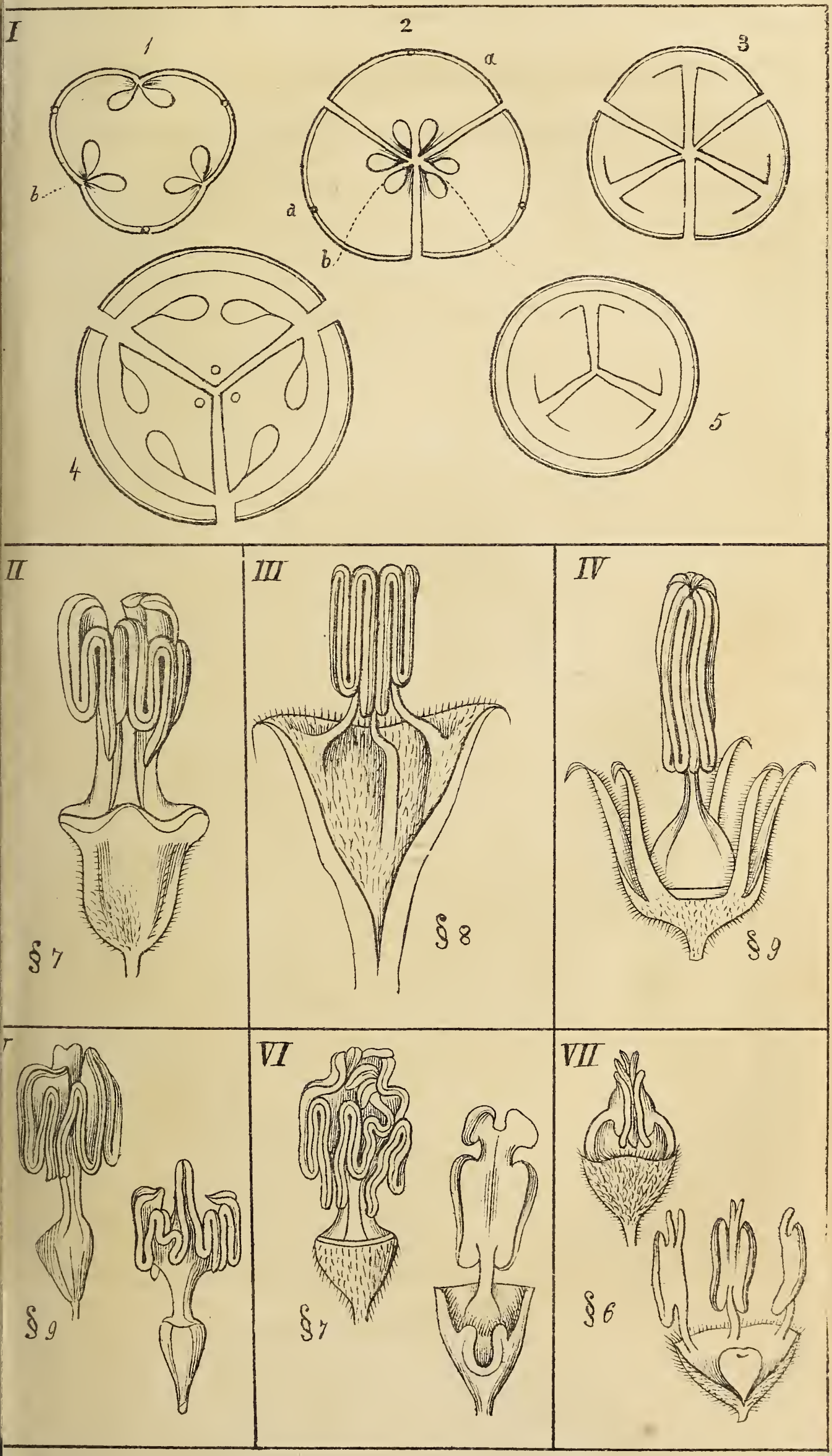
1 *G. Ceylanicum* (Arn.). Leaves deeply 5 lobed; perianth glabrous : *Bryonia tubiflora.* W. and A.

2 *G. Wightii* (Arn.). Leaves 3-5-angle-lobed; perianth hairy. *Courtallum.*

§ 9.—*Filaments usually tri-adelphous, inserted at the base of the perianth; connectiva entire, unless when produced into appendages beyond the anthers; anthers linear, posticous, bent upwards and downwards (calyx campanulate or rarely infundibuliform.)*

25 Cucumis (Linn.). Corolla 5-parted : anthers tri-adelphous, or all of them slightly cohering, with appendages at the apex! Peponida fleshy, indehiscent, or rarely irregularly dehiscent, polyspermous : seeds ovate, compressed, sharp edged. *Asia, Africa* and *America.*

26 Cucurbita (Linn.). Corolla campanulate, 5-cleft : filaments triadelphous at the base or quite monadelphous; anthers all cohering, without appendages : peponida fleshy, indehiscent, polyspermous : seed with a slightly thickened edge. *Asia and America.*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§ 7
VII
§ 6

NATURAL HISTORY

27 Elaterium (Linn.). Petals scarcely united at the base: filaments monadelphous, anthers all cohering: style thick; stigma capitate: fruit a coriaceous, one-celled, few seeded capsule, bursting elastically by two or three valves. *America.*

28 Schizocarpum (Schlch.). Corolla infundibuliform, quite entire: filaments 3-adelphous: anthers all cohering; peponida many seeded, bursting by several valves that cohere by their apex. *Mexico.*

29 Coccinea (W. and A.). Corolla campanulate, segments acuminated: filaments monadelphous, anthers tri-adelphous, conniving, without appendages: peponida somewhat baccate, many seeded. [Usually of an oblong oval shape and bright red when ripe]. *East Indies.*

§ 10.—*Filaments monadelphous, connate into a column, which is capitate at the apex, and then bearing the gyrose posticous anthers.*

30 Cephalandra (Schrad.). *South Africa.*

EXPLANATION OF THE PLATE.

Fig. I.—1. A tricarpellary one-celled ovary—that is, the placentiferous margins of the carpellary leaves meeting in the circumference, and bearing their ovules on the walls or parietes of the cell.

a Supposed position of the midrib—*b* placentæ parietal.

2. A tricarpellary 3-celled ovary, the laminæ of the carpellary leaves folded inwards, until they meet in the axis, and there produce ovules.

a Supposed position of midribs—*b* plantæ axillary.

3. An imaginary section of a pepo explanatory of Dr. Arnott's theory of its construction; copied, but with some modification, to render it more explanatory, from his figure in the Encycl. Brit.

a Supposed position of the midrib—*b* the placentiferous margins represented introflexed, reaching nearly to the dorsal suture, dividing the carpel into two cells.

4. Section of the ovary of Coccinea Indica; the calyx divided in the line of the partitions of the carpella, by which they are permitted to fall apart.

5. Section of the same; the parts *in situ.*

Fig. II.—Section 7. Momordica Charantia.
III.—Section 8. Trichosanthes anguina.
IV.—Section 9. Cucurbita maxima.
V.—Section 9. Coccinea Indica.
VI.—Section 7. Lagenaria vulgaris.
VII.—Section 6. Mukia scabrella.

Obs.—These dissections have been prepared with the view of showing that sections 7 and 9 are not distinguishable by the characters assigned—the anthers being lobed or entire—and that, by taking our characters rather from the form of the anthers than the insertion of the filaments, Trichosanthes and Cucurbita might be advantageously placed in the same section, leaving the character taken from insertion available as a generic distinction between them.

VI.—*Notices of some Roman Catholic Books, existing in the Telugu Language.—By* C. P. BROWN, *Esq.*

The Roman Catholic Missionaries, who visited India about the year 1600, were diligent in instructing the Telugus; and their efforts are briefly described by NAVARETTE, one of their number, who, after being employed in China, was transferred to India and subsequently to South America.

The Abbé DUBOIS gives no very complimentary account of the success of the Catholic Missionaries among the Tamils. The *imitation of the Vedas*, written in Sanscrit, under the guidance of *Robertus de Nobili*, has been described by Mr. Ellis, in the Asiatic Researches; and it is to be wished that a sketch could be obtained of all the Roman Catholic treatises existing in Tamil: some of which have been noticed in the last number of this Journal, in the Memoir of BESCHI. Those which are written in Telugu, will now be described. There may perhaps be others: but such are unknown to the native christians who obtained for me the following few volumes.

One of these is a translation or abridgment of the Old Testament history: this is written in a clear and easy style, and may be useful to those who are beginning to study Telugu. It is evidently translated from the Latin Bible: and the ten commandments are arranged as they are in English Bibles.

The version of the Gospels forms a separate work; it is a *Harmony* or selection of chapters, taken from the different Evangelists, so as to form a continuous narrative. Some Romish legends are interspersed; particularly those regarding the Virgin: and paraphrastic remarks are mingled with the text: thus, the Lord's Prayer is quadrupled in length.

The dialect used in these works is very respectable. A few *Italian* words are used; as *Sancto spirito*, and *Pascha*, with *Baptismum*, and

Baptista; there are also a few Hindustani expressions. There is in some passages an appearance of a foreigner's composition, but in general the style is unobjectionable, unless as being a little pedantic.

These books (all unprinted) are usually styled the *Veda:* and those who desire to obtain them should enquire for them under the name of the *Christian Veda.* But the New Testament is often denominated *Suvisesham:* which denotes Good News. It is to be observed that in the Gospels the *doctrinal* portions are usually omitted.

Another volume much read among natives is usually called *Jnana Bodha*, or Instruction in Wisdom, but I do not find any title in the volume. It is a mere set of sermons on various doctrines, wherein there are many allusions to history (even including a notice of *Cæsar Borgia*) but there are few references to the Bible. It is not well written or interesting. An European reader, if acquainted with Telugu, will understand it with ease: but to the natives it is extremely obscure.

There are some trivial compositions which call for little notice: such as the *Devara Talli Dandacam*, or "Chant to the Mother of the Lord." Another hymn or chant is denominated *Jesu Natha Swami Dandacam.*

There remain two volumes which call for more notice, being the *Tobhya* Charitra and the Vedanta Rasayanam. These are written in verse.

The first of these is the legend of Tobit: written in *padya* metre, and contained in three cantos. It is an amplification of the story described in the Apocrypha, and possesses no great literary merit. It is the composition of *Pingala Ellaya*, the son of Mágaya, whom the introduction shews to have been a Jangam. The Jangams narrate regarding their teacher Basava, a variety of legends; part of which, particularly those describing his birth are mere imitations of the first book of the Ramayan: and these stories are in the present poem related regarding Tobit.

The Vedanta Rasayan is entitled to more particular notice: like the poem last mentioned it is in the *padya* metre, or stanzas, and is the composition of Ananda, son of Timmaya, of the Mangalagiri family: the style is purely classical; and judging from circumstances we may consider it to have been written about a century ago. The author's poetical powers are considerable, the taste he shews is good; and the extent of his learning, particularly in Sanscrit, and the classic dialect of Telugu, has gained him much applause. His poem which we may denominate *A summary of the Gospels*, has been mentioned in a former essay, but it merits a more detailed notice. In the usual mode pursued by Catholic writers it describes the five *sorrowful*, and the five *joyful mysteries*, and omits much of the di-

dactic portion. The expressions *Spirito Sancto*, *Baptismum*, &c., are retained. The four books with the introduction contain nearly 4000 lines.

The first book opens with a prayer for the divine blessing on the poet's patron. Precisely following the braminical method, he now describes the family of his patron and that of *Mallarusu*, who is the pupil or questioner: the replies given by the teacher constituting the poem. This mode has been followed by Principal MILL, in his Sanscrit poem, entitled " CHRISTA SANGITA."

The preface being concluded (in 260 lines) the author gives an introduction, which seems superfluous; describing the occurrence of an eclipse: a conversation regarding which leads to the real theme of the poem. Mallarusu applies to a hermit named *Parvataya*, or, *Jnána Bodha Muni*, who undertakes to describe the christian religion. As a preliminary, he attempts to describe Deity, and refutes the braminical ideas on this subject; he urges the adoration of God alone. He next describes creation: and the nature of angels. The fallen angels, and the devil as a tempter. These subjects are treated partly in the style of the Latin theologians and partly in a new method such as a native of India might be expected to devise. The system of Hindu idolatry is next combated, and several of the absurd braminical legends are very justly weighed. At the close he says " Let us then desist from regarding Siva, unless in the light of a foe: and let the emblems of such false gods be laid aside."

The second book opens with a benediction in the name of Christ The poet now describes creation. His description of Eve's beauty is quite in the Hindu style, though free from grossness An exuberant description of Paradise. The forbidden fruit. The Temptation and Fall. Then follows a discussion on the origin of evil.

The poet avoids mentioning that Adam and Eve were naked—that the devil was in the serpent's form;—that the curse was inflicted—that Cain slew Abel: indeed he throughout the work passes over in silence whatever he thinks might deter a Bramin from reading his poem.

He now passes to the history of Abraham, then to the birth of the Holy Virgin " who lived with Joseph as with a brother." The birth of Saint John. The Annunciation. The naming of John, and the birth of Our Lord, are described in full detail, and in a very poetical style, (but the circumcision is not mentioned). The hymn sung by the Angels is well executed. The birth is stated to have taken place " in the

month Margasira" which answers to December. Here arises a question why the Lord was born not in a palace, but in a stable. The coming of the "Three kings." The alarm of Herod. The interview with Simeon. The flight to Egypt. The disputing with the doctors in the temple.

The third book (which the student should peruse *first*) contains about 1000 lines. It commences with a discussion regarding the Trinity. Then follows the Baptism: with an elaborate picture of the river Jordan. The Temptation; various miracles. The raising of Lazarus is minutely described, in a very poetical manner. The last supper. (But the bread and wine *are not mentioned*). The betrayal to the Jews. The crucifixion.

The fourth book (of similar length) gives further details, with a discussion regarding the possibility of such a death suffered by our Lord. Several apocryphal circumstances are introduced: with a discourse to prove the doctrine of purgatory. The Resurrection. The journey of two disciples to Emmaus is minutely and well described. The doubting of Thomas. The Ascension. The descent of the Holy Spirit. Then follow some apocryphal stories, such as the resurrection of the Lord's mother, "on the third day." Peter appears as the head of the church. A summary of doctrines. The Ten commandments (called Dasa Calpana): the second is as usual omitted. Instructions regarding baptism and prayer: which is to be offered before the crucifix and the Virgin Mary. The teacher concludes with very brief instructions regarding the Eucharist. The disciple returns thanks and is baptized.

It is much to be regretted that any apocryphal doctrine should be admitted into a poem written in so excellent a spirit of piety: but the author has adhered strictly to the line laid down by the church of Rome. In poetical merit this poem may probably stand as high as the *Tembavani*, written in Tamil, by the celebrated Beschi. That distinguished genius has introduced into his compositions some of the elegancies of Latin and Italian literature: but in the *Vedanta Rasayanam*, we have a work of great beauty, which in every page bears marks of the author being a native of India.

This poem has been well edited, and illustrated with a verbal commentary or explanation, as the style in some parts is too much elevated to be generally understood at the present day without such aid. For education is at present in the lowest state among the Telugu people; they being nearly as illiterate as were our ancestors at the period when the invention of printing led to the restoraion of learning. A careful study of the *Vedanta Rasayan* may ultimately produce a desire to emu-

late a poem of merit so distinguished, and will prove that the Telugus possess a christian poet who may rival in talents a GEORGE BUCHANAN, or a CASIMIR; and who further, like MILTON, had the advantage of writing in his native tongue.

VII.—*On the Fossils of the Eastern Portion of the Great Basaltic District of India.—By* JOHN G. MALCOLMSON, *Esq.*, F. G. S.

CONTENTS.

Introduction.—Objects of the Memoir.
General Sketch of the Physical Features, Hydrography and Geology of the Basaltic and Granitic Districts.
The valley of the Nerbudda, Godavery, Kistnah, and Pennar.
Granite platform between the Kistnah and Godavery.
Iron ore, mines, and manufacture of the steel.
Description of the Sichel Hills, and of the Freshwater Shells.
Country between the Sichel Hills and Nagpoor.
Origin of Minerals in Trap Rocks.
Description of the Lonar Lake and analysis of the water.
Age of the diamond sandstone and argillaceous limestone.
Inferences respecting the Freshwater Fossils.
Other districts in India in which similar Freshwater Shells have been found.
Relative age of the Laterite and Trap.

INTRODUCTION.

The principal objects of the following paper are, to submit to the Society an account of a series of fossils discovered in the eastern part of the great basaltic district of India; and to endeavour to arrive at some approximate conclusion respecting the geological era of this basaltic formation, which, extending over more than 200,000 square miles, conceals, breaks up, or alters all the other rocks from beneath which it has forced its way. Of the eruptions to which this rich and romantic country (formerly including several considerable kingdoms) owes its existing form, a late President of this Society remarks*, that the mind is almost lost in the contemplation "of their grandeur;" but "that unfortunately the relative age of the eruptions must remain for the present undetermined, no vestiges of secondary or tertiary formations having been detected within the region." Having therefore, in 1832, collected a series of la-

* See Mr. Murchison's Anniversary Address, Geological Proceedings, vol. i. p. 454.

custrine fossils, probably referable to the tertiary epoch, from a portion of this district extending 140 miles north and south, and having procured others from localities to the north and west of that which furnished my own collection, I am induced to submit the specimens to the Society*. If they should be deemed of sufficient value, I wish a selection to be deposited in the museum, to afford a means of comparison with a duplicate set, which I shall forward to the Asiatic Society of Bengal.†

But it is not alone by supplying some data from which to infer the relative age of the great trap formation, that these specimens are valuable. They will afford the means of connecting the great sandstone formations of the south and north of India, containing the celebrated diamond mines of Parteal (Golcondah), Bangnapilly, and Panna, as well as the limestones and schists associated with them ; and which, from the latitude of Madras to the banks of the Ganges, exhibit the same characters, and are broken up or elevated by granite or trap rocks, in no respect differing in mineralogical characters or geological relations. A few remarks on these formations, and the physical geography of the countries in which they occur, will be a necessary introduction to a more particular account of that portion of the trap district in which the fossils were found, Mr. Calder's sketch not being sufficiently detailed, and the map attached to his memoir containing some errors of material importance.‡

GENERAL SKETCH OF THE PHYSICAL FEATURES, HYDROGRAPHY, &C.

An elevated tract to the north-west of Bundlecund (not included within the range of the Map,) may be considered as the geological connexion between the provinces watered by the southern branches of the Ganges and the Deckan, including all the countries to the south of the Nerbudda. From the north of this plateau, which extends far to the west, a number of great rivers descend, by a series of rapids and falls over sandstone escarpments, into the valley of the Jumna and the Ganges. From the east and south of the same tract, the Mahanuddy river collects a great body of water, and after a comparatively short course through countries little known, but containing the diamond mines of Sumblepoor and extensive trap and gneiss formations, empties

* See Plate drawn, engraved, and described by Mr. James de Carl Sowerby.

† The series of specimens presented by Mr. Malcolmson to the Geological Society have been arranged in the foreign department of the museum.

‡ Asiatic Researches, vol. xviii.

itself into the Bay of Bengal, not far south of the Delta of the Ganges.

The Nerbudda, which flows in an opposite direction, is more interesting in a political and geological point of view; and the extensive countries through which it passes have been more carefully investigated than any other part of the Peninsula. This river takes its rise to the west of Amerkantack, and traversing a country of granite, sandstone, and basalt, abounding in iron and the finest dolomitic marbles, reaches the Indian Ocean through the alluvial plains of Guzerat. At Jabulpoor and in the neighbourhood of Saugur, fossil mammalia, shells, and silicified palms have been recently discovered. Fossil shells have also been found in some of the trap hills, which have broken up the sandstone near the sources of the Taptee. This river is separated from the Nerbudda by a range of basaltic mountains; and having the same direction as the Nerbudda, its whole course appears to be in the basaltic formation. (See N. W. corner of Map).

All the other great rivers of the Peninsula, including the Godavery, Kistnah, Pennar, and Cauvary issue from the western Ghâts, from the summits of which the country slopes gradually to the east, except at the extreme south, where the descent to the plains of the Carnatic is considerable and precipitous.

The Godavery (see Map,) rises in the basaltic region described by Colonel Sykes, (Geol. Trans. vol. IV pt. 2, 1836) and, greatly increased in size, it enters the granitic table land of the Deckan, and flows at the southern foot of the Sichel Mountains into a sandstone and argillaceous limestone country. This district is similar to that of Bundlecund and Malwa; it also contains diamonds, and has been much broken up by erupted rocks. From the north, the Godavery derives large supplies of water from the great rivers rising south of the Nerbudda and the Taptee, in basaltic tracts, the soil of which being retentive of moisture, the water is everywhere near the surface. From the south it receives only the Munjerah river, which, flowing through arid granitic plains, furnishes but a scanty addition of water, except during the rainy season. Through a pass in the gneiss mountain of Papconduh it enters the plains of the Coromandel coast. In this district the sandstone reappears, at an elevation little above that of the sea; but basaltic hills, several hundred feet in height, in which marine fossils have recently been discovered, exist almost within the delta formed by its sediment.

The Kistnah derives its waters from a number of considerable rivers, rising in the basaltic and gneiss summits of the western Ghats, which condense the greater part of the clouds carried by the south-west monsoon from the Indian Ocean. Flowing through the territories of the

southern Mahrattas, a country covered with a rich basaltic soil, and abounding in schistose limestone, sandstone, granitic rocks, and basalt, it enters the granitic platform of the Deckan, the limits of which in this direction are unknown. The limestones and sandstones, however, soon reappear on descending the river, and extend across to the basin of the Pennar, and as far as the ascent to the granitic platform of the Mysore. It is on the banks of the Kistnah that the richest diamond mines occur, and that the sandstones acquire their greatest elevation, amounting to more than 3000 feet ; the river passing through mural precipices of this rock and of the schistose limestones to be presently described. It then enters the plains of the Carnatic, where the same rocks occur, sometimes a little elevated above the level of the sea, at others forming the caps of granite mountains, or broken up by varieties of greenstone and basalt. Thence, passing through a narrow gorge in the gneiss hills of Bezwarrah, it enters the alluvial plains continuous with the delta of the Godavery. Its waters, however, are more loaded with mud than the last-mentioned beautiful river, and the deposit of new land may be seen, by the inspection of a common map, to be proportionably great.

The Pennar is comparatively a small stream, but of much geological interest, the greater part of its waters being derived from the districts in which the diamond sandstones and the argillaceous limestones, on which they rest, are exhibited in their most characteristic forms, and where they are most easily investigated. To describe these strata in detail would be out of place here ; but a few of the leading facts must be stated, that the identity of the formations with those of the fossiliferous district, more immediately the object of this paper, may be rendered manifest. Like all the rivers of Southern India, granite is frequently seen in the bed of the Pennar, more especially in its southern branches, where the passes of Ryachottee lead to the granitic table land of Mysore, having an elevation of 3000 feet above the sea, or 2500 above Cuddapah, the principal town of the Pennar basin. With these exceptions, and the occasional appearance of trap through the stratified rocks, the rest of its course, till it approaches the sea, is over rich plains of black and saline alluvium, derived from the decomposition of basalt and of the stratified rocks so often referred to. From these plains numerous table lands, insulated eminences, and ranges of hills, having for the most part a direction nearly N. E. and S. W., rise abruptly, presenting mural precipices of difficult access, around the base of which the roads often make extensive circuits. The Nulla Mulla hills extending from the Mysore frontier to the basins of the Kistnah and Godavery, and the minor ranges

dependent on them, and having the same composition and direction, are crossed at right angles by the Pennar, which makes its way through them, like the Kistnah, by traversing narrow gorges, with perpendicular sides.

There is not a more remarkable phenomenon in the district watered by the Pennar than the horizontal summits of many of the ranges, and the distinct manner in which the continuity of the strata can be traced from one hill to another, although extensive plains intervene; while, at no great distance, the sandstone which forms the summits of these hills is seen on the same level as the surrounding plains. Numerous instances also occur in which the original continuity of the horizontal summits is easily traced; the strata on the opposite and nearly perpendicular sides of a valley being similar, but having a considerable dip, the beds descend to the general level of the country. A good example of this is seen, in Section 2, Pl. 6., at Chintagoouta and Gundicottah. These anomalies were at first quite inexplicable, nothing appearing in the valleys but a rich alluvium, nor on the summits (which are reached with much difficulty) but a sandstone perfectly horizontal, and divided into huge tables by perpendicular partings, sometimes separated several feet from each other, and filled with broken pieces of the rock. This jointed structure is common to the sandstone, the schistose beds on which it for the most part immediately reposes, and the stratified limestone into which these schists pass insensibly; but the size of the tables so formed, varies from rhombs of a few inches, in the schist and lower part of the sandstone, to enormous masses on the summits of the hills. Nowhere is this structure and the succession of strata, of which it is characteristic, better seen than in the table land in which are situated the celebrated diamond mines of Bangnapilly and others now deserted. From the accompanying plate some idea will be gained of one of these mines.*

The plains at the base of the table land of Bangnapilly consist of a rich black alluvium, containing fragments of basalt, jasper, and the various minerals found in the hills. It rests on a fine, compact, dark blue or nearly black limestone, which contains much argillaceous and siliceous matter. This limestone abounds with springs, and is in some places so cavernous as to afford passage to subterranean streams. Basalt protrudes in a few places near Bangnapilly. On ascending the hill, the limestone becomes more schistose, and is of a paler colour, gradually approaching in its structure and composition to clay slate, but it is far more friable. On the schist a more or less compact sandstone rests

* The plates will be given in our next number.—Ed. Madras Journal.

varying very much in colour, composition, and appearance in different places. Above Bangnapilly it contains the diamond breccia described by Voysey. As far as the shafts which I had an opportunity of observing, enabled me to judge, the breccia is not an interstratified rock, but an intermixture of the common sandstone, in different parts of the same stratum, with larger fragments of older rocks, generally rounded but sometimes angular. It is not, however, the object of this paper to describe the mines and the interesting district in which they occur further than is necessary to exhibit the type of the formation, by the study of which I was enabled to understand more clearly, the less distinct appearances exhibited by the same rocks, where they have been invaded or buried by the great basaltic eruptions of Central India. On the opposite or west side of the valley, the hill is composed of the same argillo-calcareous formation; but, according to Colonel Cullen, "instead of a sandstone cap, it is crested in its whole length with a sharp black ridge of trap rock, formed of loose blocks piled upon each other, the apparent base of which observed a pretty uniform level, nor is the ridge of much depth. Its extreme narrowness, deep black colour, and the total absence of all traces of vegetation, formed a singular contrast to the rest of the hills, which were covered with long dry grass and scattered bushes*." At a small pass some miles further to the west, the road in ascending, passes over first the dark limestone and a narrow belt of schist, then trap, which is again succeeded by limestone, and the latter by schist, nearly to the summit, "which is capped with a rock of a beautiful flesh colour, with specks and shades of a beautiful green, as if connected with its vicinity to the trap, and of so close and fine a texture as to appear homogeneous even with a lens." "The descent of the pass on the opposite side consists of a clay slate nearly to the foot, where the limestone reappears, and these two rocks continued to alternate with each other to the foot of the second Ghât, which, like all the former, was composed of clay slate capped with quartzose sandstone†."

The sandstone exhibits many varieties of grain, colour, and hardness: in some places it is white or red, and can be cut into pillars and slabs of great size and beauty; in others it is soft and friable, and its inferior beds are not unfrequently schistose, so as to be with difficulty distinguished from the subjacent rock, with which it has in one or two places been observed to alternate. Where the sandstone approaches the great granitic tracts to the south and west, it passes into a compact quartzose

* Colonel Cullen, in Transactions of the Literary Society of Madras, January 1837 p. 50.

† Ibid.

rock, as is seen on both sides of the Tripatty Valley. This passage is also observed in other places, as near the Cuddapah diamond mines, where the plentiful occurrence of basaltic pebbles shows the neighbourhood of the trap. Besides the diamond conglomerate, consisting of a great variety of minerals, seams of rock crystal occur, and a fine white quartz containing argentiferous galena, which in former times furnished the country with lead. Specular and micaceous magnetic iron ores, but containing much peroxide, and common iron pyrites, occur with the galena. As far as I have observed, the sandstone always rests conformably on the schists, although from its jointed structure it occasionally, when elevated, appears to meet the subjacent rock at a more or less obtuse angle.

The schists on which the sandstone rests, vary very remarkably in colour, being in different places blue, red, green, or pure white, in which they seem to bear some relation to the incumbent sandstone. They are also occasionally flinty or jaspideous. Sometimes they are wanting, the sandstone resting directly on the limestone, of which the schists are evidently merely the upper beds, and into which they pass insensibly, although it seldom happens that considerable effervescence does not occur on examination by tests. It is in many places impossible to say to which portion of the series any particular specimen belongs.

Voysey has classed the schists with the sandstone under the name of " (the clay slate formation ;)" I have, however, preferred to designate the deposit " argillaceous limestone," a term used by him in one of his sections as applicable to the limestone, and which well expresses not only the general character of the rock, but that also of the upper schistose beds.

The limestone is a compact rock, but the strata are usually thin, and are often intersected by vertical partings, a circumstance which frequently limits its use in ornamental architecture. Its most common colour is a light blue, passing into black ; but it occasionally occurs of a nearly pure white, and affords an admirable material for basso-relievos. On this stone the finest sculptures of the ruined city of Amrawuty are executed, and for delicacy of workmanship they have perhaps never been surpassed. Were it not for the occurrence of small crystals of quartz, the same quarries would furnish an excellent lithographic stone. Near Cuddapah the dark variety is the common building stone, and many fine columns, caryatides, and cisterns are composed of it. The stone is applied to the same objects in the southern Mahratta country, and along the course of the Godavery towards Nagpoor.

To the south and east of Cuddapah, a narrow valley, nearly 150 miles

in length, extends through the limestone, the strata of which are in some places nearly vertical, but form rounded hills. In others they are capped by sandstone, which exhibits mural precipices of much grandeur, and almost or entirely inaccessible. The strata, for the most part, dip to the N. W., resting on the granite of the Carnatic. This rock is penetrated by many dikes of greenstone, which have evidently been instrumental in elevating the stratified rocks to their present singular positions. Little has yet been ascertained regarding the thickness of these strata, which differ much even in the same range of hills. The only minerals they have been ascertained to yield, are varieties of quartz and iron pyrites, the latter of which is so abundant in a few localities, that sulphur is manufactured from it. At Jumulmudagoo I found the limestone interstratified with muriate of soda ; and it is therefore probable, that the salt diffused through the alluvial soil so extensively as to render the water of the Pennar brackish during the hot season, and the inhabitants independent of the sea-coast for a supply of that article, is derived from this source.

On emerging from the gorge in the Nulla Mulla range, the Pennar enters the plains of the Carnatic, and near its mouth flows through low hills of laterite. This deposit rests on the ordinary granite of the Carnatic, with its associated sienites, hornblende schist, quartz rock, and mica slate. It is in a rock composed of a mixture of the last two minerals, that the copper-mines of the Nellore district are situated*. In the same neighbourhood, the sandstone and argillaceous limestones are little elevated above the sea, and are continuous with the same rocks on each side of the Kistnah. They are broken through by insulated basaltic hills, in the neighbourhood of which subterranean sounds and frequent local earthquakes are reported to occur; an assertion I am the more inclined to believe, having myself experienced two slight shocks during a casual visit to the district.

Having briefly described some of the more remarkable phenomena exhibited by the southern portion of the great sandstone and argillaceous limestone formations, it will be unnecessary to enter into any detail when

* The ores are of various kinds, but the richest is a sulphuret, containing, according to Mr. Prinsep, 69 per cent. of the pure metal. The copper also occurs in a slate which Mr. Ouchterlony, of the Madras Engineers, informs me, was considered in Cornwall to be identical with the Killas. If this slate belongs to the " argillaceous limestone" formation, the fact will be of use in determining the relations of that rock to the gneiss, talc slate, and mica schist ; a subject on which no observations of any value have yet been made. The primary rocks of this district contain magnetic iron ore and corundum, both of which occur in the diamond sandstone.

we meet with the same rocks to the north of the Godavery in connexion with the fossil beds discovered in the great basaltic district.

Granite Platform between the Kistnah and Godavery.

(See Map and Section I.)

With regard to the granitic platform of the Deckan, which intervenes between the Kistnah and Godavery, much accurate information is already before the public; it will therefore be necessary only to observe, that it is intersected by numerous greenstone dikes (sometimes of greenstone porphyry), having for the greater part a direction from S. by E. to N. by W., and not very different from that of several of the ranges of basaltic mountains to the north.

These dikes, and the detached masses connected with them, are entirely composed of a crystalline compound of hornblende and felspar, without distinct crystals of augite; and I have never detected olivine in them.* The rock shows a tendency to separate into spheres composed of concentric layers and into irregular prisms; and the same structure in some degree occurs in the granite, sienite, pegmatite, &c. of the whole of the south of India. The greenstone is exceedingly hard and difficult to work, but it takes a most beautiful and durable polish, as in the magnificent mausoleums of Golcondah, the tombs of Hyder Ali and Tippoo Sultan, at Seringapatam, and in many of the sculptures of the Carnatic pagodas†. Where these dikes rise into hills, the summits only are composed of the compact greenstone, which graduates below into the granite of the surrounding country. Many of the veins of basalt in the passes of the Mysore and Neilgherry mountains differ from these, in possessing the structure of the compact basalt of Bombay and other places in the trap countries, and in branching into narrow veins, (often not an inch thick,) which traverse the granite without mixing with it; while the ordinary greenstone dikes of the Deckan are almost always accompanied by separate nodules, of greater or less dimensions, insulated in the granitic mass, the component parts of which appeared to me to be there, in most cases, arranged in larger crystals, and to be more subject to decay, than in other places. I could not resist the inference, that, at the time of the formation of these dikes, the granite was in a state approaching to fluidity; although, as some of the narrow veins can be traced for many miles through the granite, they do not appear to have been formed at the same time.

* "In a specimen in the Geological Society's Collection, taken by Dr. Voysey from a '*greenstone dike*' passing through granite at Guntoor, south of the Kistnah river, olivine s diffused amongst the other constituents of the rock." June 25th, 1839.

† It is familiarly known in India as "black granite."

Several small basaltic hills are insulated in the granitic platform in the line of route between Hyderabad and Nirmul, and they are based on decaying granite. Their flat summits and steep sides correspond with the hills of the great trap district; and the general line of bearing, of the broken ranges of which they appear to form a part, does not differ much from that of the basaltic mountains to the north, or from the greenstone dikes; but many hills are scattered over the plains to the east and west, and cross this line of route in every direction. The lower part of the hills is composed of thin tables or laminæ of a sonorous trap, and the upper of globular concentric basalt; the external layers of which are extremely friable, generally grayish, or soft and soapy to the feel, and are of a greenish tint, except where the stone is much loaded with ferruginous grains of a reddish brown colour. In some places the metallic matter has the appearance of having been partially smelted, and is of a fine red hue.

The nuclei of the " concentric basalt," which are exceedingly tough, and resist decomposition powerfully, are of a deep black colour, and contain large crystals of olivine, and small kernels of calcedony. The first of these minerals is not found in the soft external coats, yet it is so closely united with the substance of the rock as not to admit of a doubt of its being of contemporaneous formation, and not, as supposed by Berzelius*, a fragment of a pre-existing stone enveloped in the liquid matter. Small, but very characteristic specimens of calcedony are of more frequent occurrence in the softer portions of the rock, especially between the concentric nodules; but they are intimately mixed with their substance. It is remarkable, that I detached no calcareous minerals in similar situations in these hills, although the rock is so impregnated with lime as to have led to an extensive deposit of calc-tuff (Kunkur), at present forming along its base, and projecting sometimes half a foot from between the partings of the basaltic tables.—" The presence of olivine, the soft wacké in which the globular basalt is imbedded, the less crystalline structure, the passage into a porous amygdaloid, containing calcedonies, zeolites, &c., and the granite in the neighbourhood of all the smaller masses differing little from that at a distance," may perhaps be sufficient to distinguish these insulated basaltic hills from the greenstone†.

On approaching the Godavery, the granite in some degree changes its appearance, containing large and beautiful crystals of red felspar, occasionally imbedded in veins of transparent quartz, clouded with spots

* Edinburgh Journal of Science, January 1839.

† Journal of the Asiatic Society of Bengal, February 1836, p. 105.

and wavy lines of a turbid milky colour. Greenstone dikes are there more common. The river flows over granite, which is intersected by several dikes of greenstone, running more in a north and south direction than those above referred to, and having many minute white crystals diffused through their substance. The dikes project from 8 to 10 feet above the granite, and are divided into rhomboidal masses by fissures, in which lime is deposited. The bed of the river is covered by numerous fragments of calcedonies, zeolites, and other minerals found in volcanic rocks; and they have been cemented into a more or less solid calcareous conglomerate. The banks are composed of a black basaltic soil, from the lower part of which, where it rests on the granite, as well as from the divisions between the several layers of alluvium, thin slabs of a clayey calc-tuff (Kunkur) project, and are connected above with portions formed round the roots of plants, and below with other layers spread out between the different strata of alluvial earth*. These appearances sufficiently indicate the neighbourhood of the basaltic range of mountains, distinguished in Arrowsmith's large map as the Sichel or Shesha hills, but which are locally known by the name of the Nirmul range, from the large town situated six miles from the difficult pass leading up the steep escarpment presented by their southern face. None of the stratified primary rocks are seen at the foot of these hills in the line of the section; but twenty miles to the east of Nirmul, and a few miles south of the mountains, hornblende slate occurs, resting on granite and quartz rock.

Iron Ore, Mines, and Manufacture of the Steel.—The magnetic iron ore, employed for ages in the manufacture of the Damask steel used by the Persians for sword-blades, is obtained from this schist. The mines I examined, are those of Deemdoortee, but the ore is extensively distributed. The minute grains or scales of iron are diffused in a sandstone-looking gneiss or micaceous schist, passing by insensible degrees into hornblende slate, and sometimes containing amorphous masses of quartz. The strata are much broken up and elevated, so that the dip and direction are in no two places the same, and bear no relation to the mountains to the north.

Manufacture, &c.—The mines are mere holes dug through the thin granitic soil, and the ore is detached without difficulty by small iron crow-bars. It is then collected and broken on projecting masses of

* Further details on this part of the route will be found in some notes explanatory of a collection of specimens presented to the Asiatic Society of Bengal, and published in the Journal of that Institution for February, 1836.

granite or quartz by means of a conical-shaped fragment of compact greenstone; but when too hard to yield to this simple instrument, it is previously roasted. The sand thus procured is washed in shelving depressions dug near a tank, and the heavier parts, separated by this process, are exactly similar to Voysey's specimens of the iron-sand used in the manufacture of Damascus steel at Kona-Sumoondrum, in the same neighbourhood; but from his published papers, it does not appear that he had seen the rock from which they were derived. In other respects, all the information I could procure, accurately corresponds with that given in his interesting paper.* The ore is then smelted with charcoal in small furnaces, which have often been described. I did not see any flux used; but, although I watched the whole process, from the digging of the ore till it was formed into bars, I will not assert that none was employed. The iron has the remarkable property of being obtained at once in a perfectly tough and malleable state, requiring none of the complicated processes to which English iron must be subjected, previous to its being brought into that state. Mr. Wilkinson, who has investigated the history of Indian steels with much scientific and practical skill, did me the favour to submit to experiment a specimen of this iron as it came from the furnace. He found it extremely good and tough, and considered it superior to any English iron, and even to the best descriptions of Swedish. The Persian merchants, who frequent the iron-furnaces of Kona-Sumoondrum, are aware of the superiority of this iron, and informed Dr. Voysey, that in Persia they had in vain endeavoured to imitate the steel formed from it; a failure which could be ascribed only to the difference of the materials used, as the whole process of the conversion into steel was conducted under their own superintendence. It is also probable, that there are few places in India where an ore of equal value is so easily procured; otherwise its distant inland situation, in a difficult and unsettled country, would not have retained a reputation for so many ages. In the manufacture of the best steel three-fifths of this iron is used; the other two-fifths being obtained from the Indoor district, where the ore appears to be a peroxide. It is evident, that if the beautiful water of the Damascus blades is derived from the crystallization of the steel, the use of two very different varieties of iron, one of which has been ascertained to be of such admirable quality, must have an important influence on the appearance and quality of the manufacture.

As these mines afford a boundless supply of ore easily wrought, and

* Journal of the Asiatic Society of Bengal, vol. i., p. 245.

are situated in the neighbourhood of vast forests, and near a river navigable for boats during part of the year, it is probable, that at no distant period, when the native government has undergone some amelioration, iron may become an important article of commerce. On this account, and because, although much has been written regarding Indian steel, nothing has yet been brought prominently forward regarding the finer kinds of iron ore with which that country abounds, I will make a few additional observations regarding them.

Dr. Heyne has accurately described the manufacture of iron in the Carnatic, to the south of the Pennar river, and he states that it is, when first smelted, extremely brittle, requiring several operations to bring it into a malleable state. I possess specimens of two varieties of ore used in the district in which he observed the processes, and where I have myself seen them carried on. The one, an iron sand, collected in the beds of rivers, consists of the protoxide, mixed with much of the peroxide; the other, a red schist, is almost entirely composed of red oxide, but in the centre of the mass it affects the magnet. Not far from where this rock occurs, I collected specimens of hornblende schist, leaving little doubt as to the ores being of the same nature, the former having become altered *in situ*, in the same manner as some of the superficial strata at Deemdoortee are seen to do. I therefore conclude, that the superior quality of the Nirmul iron depends on the ore being a comparatively pure protoxide. It certainly is not dependent on the nature of the fuel, which is much the same in both places*. Captain Herbert, indeed, long ago suggested, that the superiority of the Gwalior iron over that principally worked in the Himalayahs, depended on the former being a magnetic ore, like that of Sweden; but the first accurate information on the subject was communicated by Dr. Royle to Mr. De La Beche, who states†, on the authority of that gentleman, that magnetic iron ore is extensively diffused in hornblende slate in the central range of mountains in India, and that it also occurs in the Himalayahs. This geological position corresponds with that of the Nirmul ore; but the latter does not bear any resemblance, except in its peculiar lustre, to the Menaccanite of Cornwall, to which it is compared by Mr. De La Beche;

* Iron, which has been ascertained to be superior, for many purposes, to the best German iron, has been recently imported from the western coast of India; but the mines from which it was obtained have not been examined. Captain Jervis, of the Bombay Engineers, however, informs me, that ores, powerfully affecting the magnet, exist in great quantity at Taygoor, a village of the Koncan, not far from the port from which the iron in question was procured.

† Manual of Geology, 3rd Edit., p. 435.

nor could I detect any titanium in it. With regard to the geological relations of the magnetic iron ore, it is also necessary to observe, that in India it is not confined to the hornblende schist, but is found extensively distributed in the granite and gneiss of the Carnatic and Mysore, in quartz rock near the iron works of Porto Novo; and, as has already been observed, associated with galena in the diamond sandstone of Cuddapah. The discovery of a mineral, so generally confined to the primary rocks, in the great sandstone formation, affords an additional argument in favour of the opinion of those, who consider this rock and the subjacent schists, as equivalents to the older European sedimentary formations, rather than to those of the supermedial order.

Description of the Sichel Hills, and of the Freshwater Shells.

Returning to the line of route, the granite, on approaching to the Sichel hills, becomes softer and decomposes rapidly; and the soil gradually changes to the well-known black basaltic mould, known in India by the name of "cotton ground," and, as usual, it is mixed with calcedonies, zeolites, &c. Amongst these minerals were some fragments of a red colour, and considerable specific gravity, though full of irregular cavities, and so like the slag of an iron furnace, that I considered them to have had that origin, till I discovered a considerable mass of a similar nature protruding from the granite and black soil by which it was covered. Along with these fragments were others of a semivitrified matter, containing small white crystals of felspar, and hardly to be distinguished from a piece of granite fused by Dr. Voysey in the steel furnaces of the neighbouring district. The granite constitutes the surface rock a little further, gradually passing into a black compact basalt, intermixed with many white spots, apparently of felspar. The trap then becomes softer, forming small hills of a cellular amygdaloid, abounding in cavities lined with green earth, and many of them filled with calcedonies, zeolites, quartz crystals, and, more rarely, calcareous spar, of the same kind as those, so remarkable for their beauty, in the portion of this formation described by Colonel Sykes (Geological Transactions, vol. 4, p. 422*). The crystals also occur in seams, or are diffused through the trap; and in both cases

* A beautiful variety of chabasie, having the angles replaced by triangular or pentagonal faces supporting a rhomboidal surface, of which beautiful specimens abound in certain localities of the western portion of the formation, has not been met with in this neighbourhood; but, like some other minerals of the basaltic district, it is not generally diffused in the rocks where it is most abundant; so that I have travelled for several hundred miles without meeting with it.

are intimately mixed with its substance. In the bed of a torrent between two of these hillocks, I met with some soft, clayey, schistose fragments, and others of a siliceous character, and of a black bituminous appearance in the centre, containing very perfect specimens of the *Paludina Deccanensis* (Pl. fig. 20,) and fragments of other shells to be hereafter described. Those which I examined were converted into calcedony. A laborious research on the hill failed to discover them *in situ*; but about half-way up the escarpment of the principal mountain, which is very steep, and composed of concentric nodular basalt, imbedded in a soft greenish wacké, a narrow band of a singular quartz rock projected about two feet from the surface. It was remarkably scabrous, of various shades of white and red, and had cavities on its surface covered with fine silky crystals. It had every appearance of having been forced into its present situation, when the basalt covered and partially melted the bed to which it belonged. Many fragments of this rock were found below with the shells; and it was again met with, together with the same and other fossils imbedded in basalt, near Hutnoor. The specific gravity of this rock is 2·473, and some of the specimens effervesced feebly in acids, a portion of lime being dissolved; circumstances in which it corresponds with a similar formation found by Voysey, associated with shells, probably of the same kind, at Medcondah (south of the Godavery), an insulated basaltic hill resting on granite, to which I shall have occasion again to refer. The highest summit of the hills, above the locality of the fossils, is conical, but it is capped by a perfectly horizontal stratified rock, the nature of which I could not determine. It is most probably tabular basalt, although that rock is seldom found in similar situations.

Such are the appearances presented on ascending the difficult pass leading up the steep escarpment of the Sichel hills, which form the southern boundary of the eastern portion of the great trap formation of Central India. The hills extend from the junction of the Wurdah and Godavery rivers (the basins of which they separate), till they are lost in the gradual rise of the country to the west, near Lonar (lat. 20°, long. 76°, 30′), in the province of Aurungabad. Their direction is W. N. W., and, as far as can at present be inferred, they seem to be continuous to the east with numerous ranges of basaltic, sandstone, and granitic hills, extending to the Eastern Ghàts, at the lower parts of the course of the Godavery. The extreme breadth of the range, from the foot of the Nirmul pass to the town of Yedlabad, (nearly on a level with the plain country of Berar,) is about 40 miles; but several smaller hills having for the greater part the same direction, are intimately connected

with them to the north, as far as the Wurdah river, which has an elevation of little more than 600 feet above the sea. The Sichel hills are arranged in terraces, with steep sides having projecting spurs, and their summits rise occasionally into conical elevations with rounded or flat tops. They inclose narrow valleys abounding in streams, or support table-lands covered with black soil strewed with trap boulders, and having water everywhere near the surface. A thick wood and grass jungle, composed of very different plants from those common on the granite hills, cover the whole tract, with the exception of the flat summits and some of the terraces, and render it unhealthy for the greater part of the year. The basalt of which they are composed, is generally globular, the spheroids being sometimes of great size; but in many of the watercourses, even of the elevated table-lands, it has a stratified appearance. Small basaltic columns are also met with on the crests of some of the spurs and higher ridges; and where they occur, no fossils and few minerals are found. Granite not only forms the base of the hills at Nirmul to the south, and Yedlabad to the north, but part of the mountains themselves, the basalt being seen to rest on decomposing granite about the centre of the range, in a deep ravine, through which the Koorm river passes; it also again appears high in the table-land to the north of that river, and in one of the terraces of the northern descent, where the most extensive fossil beds were found. Further detail is unnecessary, as Dr. Voysey's admirable description of the Gawilghur mountains, forming the northern boundary of the great and fertile valley of Berar, as these hills do its southern limits, applies equally well to both ranges*.

The fossils were first discovered *in situ*, near Munoor, in the basaltic table-land north of the Koorm river; and were subsequently found in the descent of the hills towards Hutnoor, and in different parts of the Mucklegundy pass, leading into the Berar valley. They consist of numerous gyrogonites; two species of Cypris; two, or perhaps three, species of Unio; and many individuals referable to the genera Paludina, Physa, and Limnea (see Pl.). The rock in which they occur, varies in different places. Some of the finest specimens were procured from a red chert with scabrous furface, having silicified shells distributed throughout its substance, or projecting from its surface. The chert is deeply imbedded in the nodular basalt, from which it projects in some places several feet. The finest specimens of Unio occur in a beautiful gray chert, imbedded in the basalt, or resting immediately on it, the under surface being plain and smooth, while the

* Asiatic Researches, vol. xviii.

upper is rough, from portions of the large shells which project from it. On breaking up one of these masses, it was found to contain entire Unios, many of them having the valves connected and closed, or partially open; the interior being filled with the same chert, spotted with fragments of shells, minute univalves, and fine specimens of the two species of Cypris, which occur so abundantly. Some parts of the rock exhibit a mixture of sand, clay, and fragments of shells, of very moderate hardness; but the greater portion consists of chert, the materials of which are occasionally arranged in a beautiful, light blue, enamel-like substance, around irregular cavities containing crystals of purple quartz. Some portions also exhibit a minute vesicular structure; and the whole appearance of this beautiful rock forcibly impresses the mind with the conviction, that it owes its present appearance to the action of the great basaltic eruption, which has enveloped it and the organic remains. The greater number of the shells are converted into chert, but a few retain their original structure; and in some instances the calcareous matter has been converted into crystals of calcareous spar. Many internal casts of entire shells are found in the substance of the rock, to which they are united at a few points only, a greater or less space being left unoccupied; in others, the entire shell is converted into siliceous matter, retaining the appearance even of the ligaments unaltered; and fortunately, in a few cases, the hinge and teeth are excellently preserved.

Numerous fragments of shelly rock, differing much in appearance, lay scattered about over the table-land; consisting partly of a fine blood-red chert, like that above described, and containing the same shells. The gray chert was more sparingly distributed, and the Unios did not occur in the other fragments. Some of them, composed of a tough white clayey stone, so soft as to soil the fingers, contained Physæ, Paludinæ, and Limneæ, mostly converted into calcedony, but others also retained their original structure, and effervesced with acids. Portions of charred vegetable matter, resembling small fragments of grasses and reeds, occurred in these and the harder cherts. Other specimens are composed of a greenish blue crystalline mass, resembling an ore of copper, (but it is of low specific gravity, and contains no trace of that metal,) and the shells contained in them are converted into the most beautiful crystalline quartz, retaining the form of every convolution of the Physæ and Paludinæ. The cells of this stone are often coated with fine silky crystals. Masses of a hard coarse chert, consist almost entirely of Gyrogonites, but contain many of the same Physæ and Paludinæ. This rock appears to have formed beds of about half a foot in thickness; but

it was not discovered *in situ.* A stratified rock was however found in the neighbourhood, resembling some specimens of the argillaceous limestone of the diamond districts, but consisting of a compact whitish chert, which contained Paludinæ, and the finest specimens of Gyrogonites (Plate, fig. 1). Night prevented the connexions of this rock from being determined : the strata were, however, ascertained to be of considerable extent, and to be much buried in the soil ; there were also numerous fragments of siliceous rock, partly converted into a black bituminous flint, or a coarse quartzose rock, partially altered into calcedony, by which most of the shells were also replaced.

The masses of red chert protruding from the basalt contained, besides the Testacea, small portions of silicified wood, and what I consider to be the fragment of a bone, and of the tooth of a mammiferous animal. The specimens, however, are too imperfect to admit of any certainty as to what they really are ; but it is not unlikely that such remains should occur, and I therefore do not suppress what may lead to a more successful inquiry

On descending towards Hutnoor, granite, presenting a concentric, ligniform surface, from the unequal decomposition of the quartz and felspar, occurs at a short distance from the fossils*. With this exception, the basalt continues of the same character as before, and fragments of red or deep black chert, containing Paludinæ, are found in the beds of torrents ; and at Hutnoor they occur in the trap. There is much calcareous matter mixed with the soil, or collected in nodules, and it appears to be derived from the lime contained in the basalt, or between its laminæ. On the pioneers attached to our camp penetrating, at Elchoda, through some strata of tabular basalt to obtain water for the troops, seams of a pure white, pulverulent lime were found between the layers†. At Hutnoor fragments of a compact blue limestone, not to be distinguished from that of the diamond districts, were collected ; and the rock to which they belonged, was found in the descent from the first of the three principal terraces by which the road leads to the northern base of the hills. The strata were much inclined and broken, but the forest was so thick, that I could not trace them for any distance. After descending to the second terrace, the surface rock suddenly changes to a white, horizontally-stratified limestone, almost entirely composed of large bivalve shells, the edges of which decomposing more slowly than

* A similar appearance has been observed at the foot of the Nirmul pass, at the iron mines of Deemdoortee, and in Bundlecund.

† The same was observed in Bundlecund by Captain Franklin. (Asiatic Researches, vol. xviii.)

the cement, the natives have applied to it a name signifying impressions made in clay by the feet of sheep. The thickness of the bed in one place, where it is intersected by a torrent, is 12 feet, and it rests directly on red granite A great spur, from the upper part of the mountain, extends across the terrace, rising precipitously above the fossiliferous limestone, a few hundred yards from the spot where it rests on granite; and has buried the continuation of the stratum under an accumulation of basaltic *débris.* Where the limestone becomes concealed in the basalt, a friable, gray, cellular mass, resembling ashes, occurs, apparently imbedded in both these rocks. The fossils are composed of granular limestone, the matrix consisting of calcareous matter mixed with the ash-like substance, and small fragments of granite. Some of the shells are of great size, but they are ill preserved, and I found only one specimen with the valves united. These shells, I erroneously considered to be marine (principally from the appearance of those represented in Plate, fig. 4 to 8, and some of the large flattened specimens). Mr. Lonsdale, however, who had the kindness to examine some of them, considered their general character to be that of fresh-water species. I had previously detected, in a fragment of a compact argillo-calcareous stone found at the bottom of the little cliff where the granite is seen to underlie the fossils, a number of very perfect Melaniæ; I therefore re-examined the different specimens, and detected in them fragments of the same kind as those in the limestone; and Mr. Sowerby has since been able to extract from the latter, specimens sufficiently distinct to be identified with the *Unio Deccanensis* (Plate fig. 4 to 10), found in the chert at Munnoor, and another species (*Unio ? tumida*, fig. 11 and 12,) not yet discovered elsewhere. No other fossils were found in this locality.

When it is considered, that the accumulation of freshwater shells occurs on the precipitous descent of a mountain range, ascended with much difficulty by travellers, it will be evident that the aspect of the country has been entirely altered since these animals lived.

COUNTRY BETWEEN THE SICHEL HILLS AND NAGPOOR.

Towards the foot of the pass, the rock changes from the nodular basalt to amygdaloid; and near its junction with the granite, masses of greenstone porphyry, with large crystals of felspar, occur. The granite then reappears, protruding in rounded masses through the soil of the level country around Yedlabad. The bed of a stream near that town is strewed with fragments of blue limestone and schist, resembling those of

the basins of the Pennar and Kistnah ; and higher up the stream, a fine white quartzose sandstone, having a few imbedded fragments of quartz, is found *in situ*. It dips at a slight angle to the south-west*. The surrounding country is covered by a deep basaltic soil, so that the rock on which it rests could not be discovered ; but the argillaceous limestone, passing, in its upper strata, into a greenish or red schist, is traversed by a stream a few miles to the north. Short ranges of trap hills, some of them at nearly right angles to the Sichel mountains, occur to the north-east ; and beyond them, an extensive tract of sandstone has been traced for a great distance along the Wurdah.

At Zynad, argillaceous limestone appears on the surface for several miles, and agrees in every particular with the compact marbles of the diamond districts of the Pennar and Kistnah. The strata sometimes dip at an angle of 40 degrees, but they are in general nearly horizontal, the edges of the layers being disposed in steps on the slopes of gently-rising grounds. Rock crystal and calcareous spar are distributed in thin seams between the strata, as well as through the substance of the rock ; and along the vertical partings of the strata, there are rows of circular cavities, which are generally empty, but are sometimes filled with calcareous concretions. In a few instances, these hollows occur out of the line of fissure, and entirely penetrate the stratum, being connected below with horizontal channels of the same kind. On the surface, calc-tuff (Kunkur) is very abundant, often adhering to the strata, or investing fragments of the rock.

The same appearances are seen near the diamond mines of Chinoor on the Pennar, where the strata are much disturbed, and basaltic pebbles cover the banks. The only explanation which can be offered of the phenomena in both those distant localities is, that the extrication of gaseous fluids and water from below, had taken place in the lines of fissure, and had dissolved a portion of the limestone, which was again deposited in the great accumulation of tuff and conglomerate so remarkable in these places. That they at all indicate the " argillaceous limestone" to be of freshwater origin, could never be imagined by any who had seen the rock in question, which, wherever it occurs in the south of India, is entirely devoid of fossils†. This supposition is confirmed by the pheno-

* Minute undulations, resembling those formed by the ripple of running water, were observed on this sandstone, in a seam not quite parallel to the line of stratification.

† This assertion may, in the progress of knowledge, be found to be erroneous ; but having carefully looked for fossils during extensive journeys through districts principally composed of this rock, I doubt whether such will be the case. Fossil plants have been reported to be found near Gundycottah ; but these I ascertained to be mere dentritic markings on the surface of the strata.

mena exhibited at the hot-springs of Urjunah, which rise in the same rock, and where bubbles of carbonic acid are extricated through round holes in the mud covering the bottom of the rivulet, the water of which, being loaded with lime, a calcareous tuff is rapidly deposited.

A gentle elevation, extending three miles to the east of the village of Zynad, is composed of this limestone, and it rises very gradually towards a small conical summit, composed of coarse vesicular basalt, which has broken through and covered the limestone. A portion of this rock appears to have been displaced in a singular manner. A wall of perfectly vertical stratification, about 3 feet thick, projects nearly as much from the general surface, and consists internally of the same limestone, as that which it appears to cut at right angles, while externally it is singularly irregular and altered, being converted into a beautifully crystalline limestone, with quartz minerals.

To the north of this place, as far as the Payne-Gunga river, the country is flat, covered with basaltic soil or rock connected with insulated trap hills, and intermixed with jaspers, resembling those so common near Bangnapilly, and perhaps derived from the argillo-calcareous schists occasionally seen in the water-courses. The pebbles of the Payne-Gunga consist mostly of calcedonies of a reddish colour, and of argillaceous limestone, and they are in many places consolidated into a conglomerate by the calcareous matter with which all the waters of the district abound. In a layer of this conglomerate, projecting from the alluvial soil of which the bank is composed, numerous recent shells are imbedded. The limestone, and its incumbent schists, are seen north of the river, and they abound in springs and streams loaded with lime, which is deposited as calcareous tuff in the water-courses. Masses of the same substance, several feet in height, project from fissures in the rock, or compose conical eminences of white "Kunkur," which are scattered over the black basaltic plains.

Proceeding a little further towards the Pindee hills, in which the principal of these streams takes its rise, sandstone appears on the south bank of a ravine; and on the opposite side, at a lower level, the "argillaceous limestone" so often mentioned, has been raised by some violent forces into irregular gothic arches, overlaid by partially broken but horizontal strata. The spaces within the arches are filled with fragments of the same rock forced from below. Hot springs, having a temperature of 87°, rise through the limestone, and globules of gas escape from round holes in the *débris* and mud covering the bottom of the ravine. On endeavouring to collect a quantity of the gas, there were found to be considerable and irregular intervals between each jet of air.

A recent calcareous sandstone is formed in the bed of the stream, by the *débris* derived from the quartzose sandstone of the southern bank being agglutinated by the carbonate of lime of the springs.

A range of low hills having rounded summits, with conical elevations projecting from their sides, runs in a north-west direction, three quarters of a mile from the hot springs. The cap of these hills, where the Pindee Ghàt passes over them, consists of the argillaceous limestone, and the large slabs of which it is composed, are fissured in various directions, slightly convex upwards; and when taken in the mass, they have an anticlinal dip. On the summit, the strata are horizontal and in several places are remarkably altered, the argillaceous and siliceous ingredients having arranged themselves into a black chert, and a mixture of calcareous matter with streaks of a white or pale blue enamel resembling calcedony. The central parts of these bands are composed of minute quartz crystals; and irregular drusy cavities, coated with amethystine quartz, occur in the blackened flinty portions. There cannot be a clearer indication of the action of heat on a rock of a mixed character than this, even when seen in hand specimens. The whole of the base of the hill is composed of the usual black concentric basalt, the nuclei of which are exceedingly hard and contain much olivine; and to its intrusion the alteration of the limestone, with its separation from the strata below, is, without doubt, to be ascribed.

Many hills composed of concentric basalt are scattered over the neighbouring country, in insulated masses or long ranges rising in terraces, and having flattened summits. The sides of the hills between the terraces are steep, and their outline is well defined; the rock also is black and devoid of vegetation. The terraces occur at very different levels in different hills, rising from the same plain; and their whole appearance indicates that their remarkable form is due to the circumstances which attended their elevation; and that they have not been subjected to any extensive denudation.

About five miles north of the hot springs of Urjunah and four miles south of those of Kair, sandstone caps a gently rising ground, covered with basaltic soil. Near the last-mentioned town, many hot springs rise in the argillaceous limestone, which has been remarkably broken up and altered by the globular basalt protruding through it in different places, in masses several of which are only a few yards in circumference. The limestone is, for the most part, nearly horizontal, but it is occasionally more or less inclined, and, as is usual with this formation, it has no regular direction or line of bearing. In a deep well near the village, the water of which is of the usual temperature, the limestone is unaltered;

but above the principal hot spring, some of the most remarkable effects of igneous action in changing a stratified rock, are exhibited. The principal part of the small hill is a whitish limestone, the stratification of which is obliterated, and the rock projects in irregular masses full of cavities passing deep into the mass of limestone, which is partly crystalline, and in many places mixed or coated with jasper and quartz crystals. Much calcareous tuff ("Kunkur") is associated with these altered rocks, and it fills up many of the cavities; it is also found in the divisions of the nodular basalt, and masses of it, scattered over the surrounding country, are the only remains of springs which have been long closed up. Some portions of the rock had the appearance, on the surface, of a semifused brick, and had assumed something of a regular arrangement, while the centre was composed of the limestone little altered. Large masses of porous scoria also lay about.

The principal springs issue at the foot of the rising ground, where the rock is most remarkably altered. Their temperature (87°) was the same as that of Urjunah, on the other side of the Pindee hills, and it did not vary during the hot and cold months of 1831 and 1833. The water of this and many other springs is said to be equally copious at all seasons, covering the neighbouring country with the richest vegetation, when all beyond is a black and parched waste. On issuing from the rock, the water is sensibly acid, and in one spring, carbonic gas escapes with the water. It is remarkably agreeable to the taste, and sparkles in the glass, as well as where the stream passes over rapids. It contains a little muriate of soda, a minute quantity of sulphates, and much carbonate of lime in solution, which is deposited on boiling, and in the bed of the rivulet, where it has formed considerable masses of rock chiefly composed of the petrified vegetation of the banks. So quickly is this deposit formed near some little falls, that shells appear to be imprisoned and entombed while adhering to the face of the rock; and tufts of grass are encrusted with sediment while their roots are still alive. If any doubt remained as to the nature of the nodular limestone, known in India by the name of "Kunkur," it would be removed by the sight here exhibited of all gradations of this substance actually forming, and varying from pulverulent lime to a crystalline rock. The water is probably derived from a great depth, the springs having, as already stated, the same temperature as those of Urjunah, and not being materially diminished by the failure of the annual rains.

Sandstone forms the surface rock in different directions over the surrounding country, but I had an opportunity of examining it carefully only at Won, eight miles north of Kair, its junction with the limestone

being concealed by basaltic soil, mixed with calcedonies, fragments of that rock, schist, and of a coarse puddingstone, which I did not find *in situ*. The hill of Won is composed of sandstone, dipping in all directions from the apex, and varying in colour from white to red and yellow. It contains also ferruginous grains or scales, either in seams or disseminated through its substance. In a fragment of this kind much resembling the cement of the Bangnapilly diamond breccia, a fossil was discovered having a compact structure and deep black colour, and it is probably a portion of a hollow, compressed vegetable, the centre of which is filled with the sandstone. It is the only instance that has come to my knowledge of a fossil being found in the sandstone of Southern India; and as the rock corresponds in geological position and mineralogical characters with the diamond sandstone, the fact is of considerable interest, even if the formations were not found to be continuous, as will be stated hereafter. The specimen is deposited in the Museum of the Asiatic Society of Bengal.

Sandstone, argillaceous limestone, and schist constitute the building-stones of the surrounding country, which is much buried under basalt, and a black alluvial soil containing calcedonies, jaspers, &c. A few miles south of Chicknee,* (where the fossils were again met with,) the red schist found above the limestone south of the Urjunah hot-springs and in various places of the diamond districts of the south, reappears, intermixed with protruding masses of basalt, which have altered it in the most singular manner,—the lime of which it is in part composed, being converted into a fine crystalline mineral, in which the red clay is enveloped or diffused, giving the rock and even hand specimens a very striking appearance. Near Chicknee, the schist rises slightly towards a basaltic ridge, in which the fossiliferous chert is likewise imbedded. The schist is divided into minute rhombs by vertical partings, in which veins of calcareous spar from an eighth to half an inch thick have been formed, and give it a beautiful, reticulated appearance. Lime is found in the schist, and portions of the red clay are enveloped in the crystalline limestone, which contains no magnesia.

The fossils occur on the surface, or are imbedded in nodular basalt over several miles, being found in blocks of indurated clay, chert, and flinty slate. The appearance of the indurated clay is the same as in some of the specimens from the Sichel Hills, but the clay is harder, full of cavities, and in some cases passes into perfect chert, or has waved lines of quartz or opalized matter diffused through the substance of the mass.

* Fossils were first found at Chicknee by Mr. W. Geddes, May, 1829.

Many Physæ, Paludinæ, and a few Limneæ of the same species as those already noticed, are found in this indurated clay or imperfect chert. Some of them are entirely converted into calcedony; others have the lime replaced by quartz, which is finely crystallized and covers the surface of the convolutions; or the columella only is preserved, passing across an empty cast of the shell. In some cases, however, the structure of the fossil is unaltered, and it effervesces in acids. Flinty slate without organic remains occurs in the neighbourhood of those amorphous masses, and many fragments of the same kind containing large compressed bivalves are scattered about. In one block of this kind, portions of palm wood mineralized by black flint, intersected by fine veins of a light blue opal, (of the same kind as occurs in some of the specimens of fossil wood from Antigua, lately presented to the Society by Mr. Stokes,) was found associated with compressed very thick bivalve shells, probably referable to the same species as those of Munnoor.

Every appearance presented by these rocks indicates the action of the semifluid basalt on the beds of mud and sand, probably derived from the neighbouring sandstones and schists, in which the shells previously existed.

At Hingan-ghàt*, a few miles further to the north, considerable fragments of silicified palms and other plants were found in a black chert lying on the basalt, and similar masses, but without fossils, were imbedded in it. I met with no organic remains to the north of this town, the whole country as far as the city of Nagpoor being covered with a rich black soil, from which insulated basaltic hills with flattened summits rise abruptly.

Of these hills the most remarkable is that of Seetabuldee, which is based on decomposing gneiss and mica slate. To Dr. Voysey's descrip-

* In examining with the microscope sections of some of the silicified wood from the district described, a specimen from the chert of Hingan-ghàt appeared to me to be bone, and Mr. Owen, who has had the kindness to examine it, has ascertained it to belong to a mammiferous animal. He has favoured me with the following note on this important fossil:

"A section of this fossil was prepared sufficiently thin to allow of its being examined by transmitted light under a high magnifying power, when it was found to possess the structure characteristic of bone. Sections of 'Haversian canals,' with their concentric lines, were everywhere present, interspersed with numerous Purkingian cells or corpuscles: the size and disposition of these characteristic parts of the osseous structure agreed with those of the bones of the Mammalia. It was highly satisfactory to find the microscopic test as available in demonstrating the presence of bone, when ordinary characters and the unassisted eye would have left the matter doubtful, as it is in reference to the determination of the teeth."—July, 1839.

tion* I have nothing to add; but as it has been inferred†, that the "flattened summits and long flat outline" of the low ranges connected with this celebrated hill, and forming the eastern part of the great trap district, are composed of basalt having the same stratified appearance as that of other parts of the formation, it is necessary to mention, that they are formed of globular basalt such as has been already described, or of basaltic columns of very regular forms, which diverge from the centre of the hill and incline outwards at an angle of 45° with the horizon, or form a figured pavement on the flat summits.

Origin of Minerals in Trap Rocks.

The lower part of the hill of Seetabuldee itself exhibits a tendency to columnar structure, caused by horizontal and vertical partings, the sides of which are coated with thin plates of calcedony, and, according to Captain Jenkins‡, of calc spar. These minerals are not confounded with the substance of the basalt, and may be the result of infiltration or sublimation of siliceous and calcareous matters. In no other situation did I meet with an example in which either of these processes would account for the occurrence of the calcedonies, zeolites, calc-spar, &c. found in the amygdaloids and nodular basalt of India. Almost everywhere, calcareous spar is more rare than siliceous minerals, which would not be the case were they derived from infiltration, if we are to interpret the past by the present operations of nature. Wherever I have met with the basalt, and in the neighbourhood of every greenstone dike or insulated mass of that rock, and under every layer of basaltic soil in India, calcareous matter is deposited, and has even occasionally a crystalline structure. In the escarpments of the Mysore ghâts, veins of basalt, not two inches thick, ramify through the granite, and are coated with a compact layer of carbonate of lime. Voysey found the granite in the neighbourhood of the basalt intermixed with calcareous matter, indications of which I have myself seen, in the deposit of tuff on the summit of granitic logging-stones near greenstone. If, then, we suppose infiltration to have deposited the calcedonies, agates, &c., &c., when chemical action is presumed to have been more powerful than at present, a greater number of the cavities would have been filled with lime than with such intractable substances, which is not the case. These are also frequently intermixed with the basalt in a manner which could

* Asiatic Researches, vol. xviii.

† Geological Transactions, Second Series, vol. 4th, p. 410.

‡ Asiatic Researches, vol. xviii., p. 199.

have been produced only by their being formed simultaneously. I have seen masses of calcedony, passing into a black mineral not to be distinguished from the surrounding basalt. They also occur in the compact nodules where no fluid could have had access, and even in the cavities of the Seetabuldee basalt, lined by an impervious glassy coat. In this rock, likewise, calc spar occurs, penetrated by needle-like crystals of the same substance, invested with a crust of the basalt and connected with each side of the cavity, and resembling chiastolite in structure. It is indeed impossible to conceive how many of the appearances presented by the agates, cornelians, or drusy cavities in calcedony, partially or entirely filled by quartz crystals, or a central mass of calc spar, could be formed in the way supposed, as the first coating of silex would effectually close out the further access of the aqueous solution of that substance; nor could layers so formed, separate into distinct cavities, having both sides covered with quartz crystals, as they are sometimes seen to do. It is, however, only by a careful study of the rocks themselves, that this can be fully understood. I have selected a few specimens to show that the majority, if not all the minerals of the Indian trap rocks, are not formed by infiltration. One of these, perhaps, deserves particular notice; it is a mass of calcedony, 8 or 10 inches in length and 6 or 8 in diameter, of a conical shape, and was found imbedded with its apex downwards between the globular basalt, and impressed with the irregularities of its surface. In another of these specimens the upper part is perfectly flat and smooth, without any impressions of the basalt, and is composed of a thick covering of cacholong, parallel stripes of which appear to indicate the slow cooling of the surface. The centre of the mass is composed of quartz crystals, radiating to the centre, which is occupied by calcareous spar impressing or impressed by the quartz. The mode of its occurrence increases the conviction in my mind, that the only correct theory of the formation of such minerals in trap rocks, is the play of the molecular attractions existing between similar particles of matter. That so eminent an inquirer as Dr. Turner should have asserted that all calcedonies, rock crystals, &c., even when occurring in volcanic rocks, are the result of aqueous infiltration*, I can only account for, by the difficulty of explaining how carbonic acid is retained at high temperatures, in any other way than by supposing a great pressure to have existed at the time the rock was in an ignited state; but of the existence of which, proof is often entirely wanting where crystals of carbonate of

* Lecture on the Chemistry of Geology, by Dr. E. Turner, Edin. New Phil. Journal, Oct., 1833.

lime occur. The phenomena exhibited by the vesicular trap, scoriæ, and porous chert associated with the Indian basaltic and fossiliferous rocks, satisfied me, that at the time of their formation they were subject to no pressure sufficient to retain the carbonic acid of the altered limestones, and of the shells and calc spar inclosed in the geodes; but no other explanation presented itself, till I was informed by Mr. Faraday of his beautiful experiment of exposing carbonate of lime in perfectly dry air to the heat of the oxy-hydrogen blowpipe, without driving off its carbonic acid. In the simple apparatus employed by him to show that the retention of the acid depended on the absence of moisture, no pressure of any consequence could be exerted on the lime. Guy Lussac has lately published some experiments on the effect of aqueous vapour in assisting the escape of carbonic acid from limestone, and concludes, that its agency is trifling*; but as he does not appear to have taken the precaution of drying the atmospheric air by passing it through sulphuric acid, as was done by Mr. Faraday, they cannot be considered as invalidating the beautiful results obtained by the latter. His observation, however, that the water contained in limestones is driven off before the carbonic acid and at a much lower heat, is important, in showing that the calcareous matter in a rock exposed to volcanic action may lose its water before the carbonic acid, and be thus reduced to the state of the carbonate of lime in Mr. Faraday's platinum tube. These facts will assist in explaining the anomalies observed in the fossils of the district above referred to, which often retain their carbonic acid when portions of the rock in which they occur have been fused by the inclosing basalt, while other portions are vesicular from the escape of gaseous matters. The whole phenomena, indeed, would admit of explanation by supposing, what must in fact have occurred, the presence or absence of moisture during the various degrees of heat to which the rocks were exposed in the progress of the eruption, and in the course of cooling. A shell, in one part of a rock, may thus retain its carbonic acid, while in another portion it may be reduced to quick lime, subsequently carried off by the water, leaving only a cast; and a third may be replaced by silica, or the form of its convolutions taken by fine quartz crystals, perhaps derived from silica rendered gelatinous by the lime with which it was ignited†.

In stating these views, I venture only to express an opinion forced on me by the phenomena under description, and which appear to explain

* Annales de Chimie et de Physique, Oct., 1836.

† For a knowledge of the fact, that lime calcined with finely-divided silica, acts like he fixed alkalis in rendering it gelatinous and soluble in weak acids, I am indebted to Capt. Smith of the Madras Engineers, F. R. S.

some of them better than the theory of pressure, which, however useful in removing the prejudices against the igneous origin of the trap rocks, has been injurious in leading geologists to admit too easily the existence of aqueous pressure, or extensive denudations of solid rocks, supposed to have confined the carbonic acid at the time of eruption. No doubt pressure is an efficient agent in some cases*, but not in many to which it has been applied.

The trap terminates in the line of section, a few miles to the north of the city of Nagpoor, and is succeeded by a red sandstone, the strata of which are bent, fractured, and converted into a compact quartz rock, at the point of contact with the granite which has burst through it. Within a few hundred yards of the ravine where these phenomena were observed, mica slate occurs, and a little beyond, some hills of gneiss. A bed of granular limestone is quarried at the foot of a conical hill of basalt, in part composed of a scabrous quartzose, and calcareous rock, abounding in drusy cavities, calcedonies and cornelians. Further north, granite veins pass through a much-elevated limestone, varying in colour from red to gray and black, and the stratification of which is nearly obliterated. The gneiss and mica slate forming the neighbouring hills are also penetrated by dykes and masses of granite†. To the north of this district are 50 miles of a wild mountain country, composed of granitic rocks, with trap in the ascents and tops of the passes; the basalt then reappears, and composes great part of the valley of the Nerbudda.

In a direction south-west of Nagpoor, the nodular basalt is the only formation met with as far as Baitool (90 miles), where granitic rocks reappear, but are succeeded by fine-grained sandstones with traces of coal, and penetrated by trap dykes ranging from S.E. to N.W‡. Here, the sandstone rises into mountains, and constitutes what appears to be the continuation of the range forming the division between the valleys of the Taptee and Nerbudda rivers; and "indurated clay," containing casts of the same shells as those of the Sichel range, also occurs.

Before proceeding to notice more particularly the fossils, and the evidence they afford of the geological era of the intrusion of the basalt, it is necessary to make some observations on the Sichel range, and the connexions of the several formations occurring in the district described. The basaltic rocks of Nagpoor and of the country to the south, have been

* Transactions of the Royal Society of Edinburgh, vol. vi., p. 120.

† Captain Jenkins, in Asiatic Researches, vol. xviii.

‡ Lieuts. Miles and Finnes, Journal of the Asiatic Society of Bengal, Feb., 1834, and Dr. Spilsbury, August, 1834.

considered by every observer to form the eastern part of the great basaltic formation of Western India, with which it is continuous, and with which it agrees in every particular of general character and mineralogical structure, and in being connected with stratified rocks, which, as far as is yet known, are of the same age. The only difference is, that towards the eastern limits of the formation, the hills are less elevated and the trap breaks through the granite and stratified rocks, while to the west the mountains are, with a few exceptions, entirely composed of basalt from the level of the sea to the loftiest summits.

Lonar Lake, &c.—The Sichel hills, which have heretofore attracted little attention in a geological point of view, terminate to the west in the neighbourhood of Lonar, near what appears to have been a vast crater in the centre of the great basaltic district. As it is the only instance of a volcanic outburst discovered in this immense Plutonic region, a more detailed account of it than has yet been given to the public, may not be unacceptable*.

It is a nearly circular or oval depression, in a country composed of tabular and nodular basalt, and sloping gently towards it on every side. It is between three and four miles in circumference at the upper margin of the precipitous escarpment which rises from the bottom of the valley about 500 feet. The extent from which the water is collected may be about six miles in circumference, but no measurements were made. Two small streams fall into it from above; one issuing from a pagoda, to which it is carried from the gentle slope behind; and the other passes over a small cliff, (Pl. B.) on which it deposits a considerable quantity of stalactite. The sides of the crater are covered with a forest inhabited by tigers and game; and the bottom is occupied by underwood, a few fields, in the irrigation of which the water of the streams is nearly expended, and by a small lake of salt and bitter, greenish water, surrounded by a muddy shore, and varying in size at different seasons. Many sweet springs issue from the saline mud, and a well is built within its highest level, the water of which stands at the same height as that of the lake, though issuing from a depth of nearly twenty-four feet.

I have carefully examined the water of this well, and that of the small stream at the pagoda above. This last had a specific gravity of 1000-6;

* Captain Alexander has published a notice of this lake in the Transactions of the Literary Society of Madras, and in the Edinburgh Philosophical Journal; but he must have examined it very cursorily or he would not have overlooked its real nature, and stated it to be unfathomable, when, in fact, the water is everywhere shallow. An extract from a private letter to Mr. Prinsep, and published in his Journal for June 1834, was written before I had myself examined the chemical history of the lake.

and 2000 grains, evaporated at 212°, gave a solid residue of $\frac{7}{10}$ of a grain, the greater part of which consisted of muriate of soda with a little sulphate, and the remainder of carbonate of lime. The water of the well below had nearly the same specific gravity, but contained in 2000 grains, one grain of solid matter, of which $\frac{7}{10}$ of a grain were soluble in water, and contained muriate of soda and a little sulphuric acid and lime ; the insoluble part consisted of carbonate of lime. Neither of the waters contained any trace of alkaline carbonates or of magnesia. It is unnecessary to go further into the analysis here, as another bottle of the same water had a higher specific gravity, and contained more lime, a circumstance sufficiently accounted for by the escape of a portion of the carbonic acid from the other specimen. The water of the lake is clear, and has no unpleasant smell ; but the mud at its bottom is strongly impregnated with sulphuretted hydrogen. In February, 1834, when the specimens were collected, the lake was in no place more than 5 feet in depth of water and mud, but when full it may be eight or ten feet deep in some parts. A layer of salt 2 or 3 inches thick covered the bottom *under the mud,* and when broken up and removed, was found to be composed of a middle plate, with radiating laminæ above, and having a striated appearance below. That obtained by diving and bringing up baskets of the black mud, at a season when there was much more water in the lake*, was also formed under the surface of the mud in lamellar spiculi radiating in every direction†. The salt accumulates slowly, and is collected only once in several years, the quantity having diminished in consequence of the mounds erected above the edge of the crater to regulate the supply of water, having been neglected ; but it is evident, from the great beauty of the specimens obtained, that the quality is not affected by this cause. The salt is collected at the end of the dry season, when the water is low ; and I observed mounds of the black mud on the banks, covered with an efflorescence of tabular crystals. The salt is used for washing and dying chintzes, &c., and is exported to considerable distances. I imagined that the water of the lake in which such large quantities of salt were deposited, was saturated ; but I found its specific gravity to be only 1027·65, a solution of the salt itself obtained from the bottom at the same time being 1148·4 ; and the water rapidly dissolved the crystals thrown into

* July, 1824.

† The natron of a lake near Maracaybo in South America occurs in the same way, the Indians breaking up the layers of salt with long poles ; and then, by diving, they remove it from under a bed of mud which covers it, and they place it in small canoes, as is done at Lonar. Journal of the Royal Institution, vol. i., p. 188.

it. On analysis, the salt was found to consist in 100 parts: of carbonic acid, 38; soda, 40·9; water, 20·6; insoluble matter, ·5, and a trace of a sulphate. This nearly corresponds to the composition of the trona or striated soda from the lakes of Fezzan, examined by Mr. R. Phillips*; but approaches somewhat nearer to the equivalent numbers of the sesquicarbonate established by that analysis, which is to be ascribed to the greater purity of the Lonar salt. The water of the lake contained besides, a little potash, muriate of soda 29 grains, sesquicarbonate of soda 4·2 nearly, and sulphate of soda ·1 of a grain in 1000 grains of the water. No lime could be detected in it, nor did I discover any magnesia. These facts confirm Berthollet's theory of the formation of carbonate of soda in the natron lakes of Egypt, viz. that of a mutual decomposition of the muriate of soda and carbonate of lime when in a pasty state.

The striated soda of Fezzan and of this lake, containing half an equivalent more of carbonic acid than can be furnished by carbonate of lime, renders some modification of his theory necessary; and the most probable explanation appears to be, that the carbonic acid by which the lime is held in solution in the mud, furnishes the acid, and perhaps indicates the existence of an unstable sesquicarbonate of that substance; which is not improbable from other facts in the history of the union with that acid. This was suggested by my friend Captain Smith, of the Madras Engineers, and explains the circumstance sufficiently.

Like most points in physical science, these observations have other and more extensive applications than that of affording an explanation of the production of natron in this lake. Carbonate of soda is extensively distributed over the surface of the soil in various countries, more especially in the basaltic portion of Central and Western India, and in the limestone districts of the south; the real relations of which have been a subject of discussion amongst Indian geologists, and inferences unsupported by fact have been drawn from it. In all the places where I have met with it, or of which detailed information has been obtained, muriate of soda and carbonate of lime existed in the soil, and the natron was found on the surface of the moist earth or mud. Near Gundycottah on the banks of the Pennar, common salt is interstratified with the upper schistose strata of the argillaceous limestone on which the sandstone rests; and on the surface of the neighbouring soil, natron, contaminated with much muriate of soda, is collected and used in washing and in glass-making. The salt associated with the limestone, and the water of a saline well dug through it, having the specific gravity of 1002·5, contain

* Journal of the Royal Institution, vol. vii., p. 294.

common salt and a little sulphate without any carbonate of soda, which is no doubt produced in the same manner as the Lonar salt. I did not ascertain whether it was also a sesquicarbonate, but I have examined a portion of native carbonate of soda from another part of India, with which Mr. Faraday had the kindness to furnish me, and I found it to be composed of a mixture of that salt with muriate of soda and a little sulphate. The same is probably true of the carbonates found in other countries in similar situations*. A specimen, however, procured from the water of a deep well near London, passing through the London clay into the chalk, which I received from Professor Daniell, contained the carbonate; but as the sesquicarbonate is decomposed by a low heat, no inference can be founded on the examination of specimens obtained, as this was, from the boiler of an engine.

The absence of Lime in the water of the Lonar Lake is a remarkable circumstance, but easily accounted for, as the sesquicarbonate of soda and the water itself precipitate the sulphate and muriate of lime, notwithstanding the mutual decomposition they undergo when in a semifluid state. The Lake of Ourmia, in Persia, is stated by Dr. Marcet to contain no lime, although of a specific gravity of 1165·07, and abounding in sulphates and muriates. This appeared very remarkable in an inland sea nearly 300 miles in circumference, situated in a volcanic country. On referring to the works of travellers†, it appeared that the streams flowing into it abounded in lime, which is deposited in large quantity in the form of a beautiful travertine. The lake is shallow, and at certain seasons much of it is nearly dry; the water is clear and transparent, but the mud of the bottom is loaded with sulphuretted hydrogen, and thick layers of salt, formed in it under the water, are redissolved on any agitation. No fish can live in it. All these phenomena are exact counterparts of those exhibited at Lonar, but no information is given as to the salt collected from its saline mud, except that Sir John Malcolm states, the salts are bitter and different from those of the sea. I am, therefore, strongly impressed with the conviction, that sesquicarbonate of soda is formed from its waters as at Lonar, and precipitates the lime. Dr. Marcet, however, has given, in the Philosophical Transactions for 1819, the results of an examination of a small quantity of this water, which he states to be as follows:

* The carbonate of soda formed by the incineration of saline plants in the deserts of Northern India, and by the deflagration of nitrate of soda and charcoal in the south of the Peninsula, must not be confounded with the natron found in the soil.

† Sir John Malcolm's History of Persia; Sir Ker Porter's Travels; Ouseley's Travels; Journal of the Geographical Society, vol. iii. &c.

1. Precipitate from 500 grains of the water by nitrate of silver... .. 237·0
2. By nitrate of baryta.. 66·0
3. Magnesian precipitate by carbonate of ammonia and phosphate of soda... 10·5

and he infers, that although it contains no lime, it yields twenty times as much sulphuric acid and six times as much muriatic acid as sea water does. But Dr. Marcet had only 150 grains of this water to operate on, and merely gives in a tabular form, along with many specimens of sea water, the quantity of precipitate caused by the various reagents; and there is no evidence that the precipitate from muriate of baryta was not, in part, caused by carbonate of soda. It is, at all events, worthy of the inquiry of future travellers*.

The Lake of Ourmia, like that of Lonar, contains potash, which I did not detect in the springs running into the latter, but its source is no doubt in the decaying (and when I visited it, burning) trees on the surrounding precipices. The sulphuretted hydrogen adhering to the clay has been supposed to be derived from volcanic sources, but I have observed the same phenomenon in the salt water inlets along the Indian coast, wherever the bottom contained argillaceous and carbonaceous matter; and it even goes so far as to form considerable quantities of sulphur and, I have reason to believe, sulphuric acid, although on this point the proof is defective. The effect is to be ascribed to the decomposition of the sulphates of the water by the carbon; and the clay probably only prevents its passing off into the air or mixing with the water, by the power of adhesion. Similar actions have gone on in former times in the alluvium on which the city of Madras stands, and probably in more ancient deposits†.

The ancient crater of Lonar seems never to have been an active eruptive vent, as no scoriæ or lava currents can be traced around its margin, which is too distinct and unaltered to admit of any probability of these having been subsequently removed by denudation. A certain degree of forcible elevation was sustained by the margin of the lake, when the

* If a carbonate exists in the water, it must be of the same composition as that of Fezzan, Maracaybo, and Lonar, as the carbonate would precipitate the magnesian salt, which the sesquicarbonate would not.

† No sulphuretted hydrogen can be detected in the water of the springs running into the lake. The hot spring of Anhoni Simhoni, in the sandstone and basaltic district between the valley of Berar and the Nerbudda, I have found to contain sulphuretted hydrogen and muriate of soda, without lime.

explosion or subsidence happened from which the great depression took its origin.

From Lonar the basaltic district extends to the south as far as Beder; to the west, 200 miles to Bombay; and northward, to the banks of the Nerbudda, near the ancient cities of Indoor and Mhysir, reported to have been buried at a remote period under volcanic eruptions. To the east, the great basaltic country of Berar extends as far as Nagpoor; and the Sichel range passes in a S. E. by E direction to the confluence of the Wurdah and Godavery, and towards the eastern ghàts. Hot springs and streams loaded with carbonate of lime, occur along the line of elevation of these mountains at Mahoor, Urjunah, Kair, Byorah, and at Badrachellum, a short distance above the pass through which the Godavery reaches the alluvial plains of the coast. The spring of Byorah is surrounded by sandstone and limestone rocks, and carbonic acid escapes with the water, which has a temperature of 110° and holds lime in solution*. That of Badrachellum, which rises in the sandy bed of the Godavery, has a temperature of 140°, and contains sulphuretted hydrogen, also sulphates and muriates of soda and lime. A sandstone resembling the cement of the Bangnapilly diamond breccia and the rock of Won, protrudes from the sandy bed of the river near the spring; and granite, basalt, and a red schist resembling that so common in the diamond districts, occur in the neighbourhood; diamonds also are occasionally found. Other hot springs are reported to exist in this line of elevation; but that wild and little-known country, far removed from the residence of any European, must long remain in a great measure unexplored.

The facts stated in the preceding pages prove that the basaltic rocks, by which so much of Western and Central India are covered, are more recent than the sandstone and argillaceous limestone of the basins of the Pennar, Kistnah, Godavery, and of the mountains south of the Nerbudda; and that, notwithstanding the frequent occurrence of these rocks in a horizontal position, they have been subjected to violent operations, which have in many instances elevated the strata and remarkably altered the rocks themselves. It also appears, from observations made on the borders of the trap districts, and in other places where the primary rocks and the sandstones and limestones are not entirely concealed, that the basalt has burst forth from numerous fractures in these formations, probably simultaneously, although often forming insulated masses. It is possible, that more than one period of eruptive violence may have occurred between the era of the formation of the greenstone dykes, so

* Journal of the Asiatic Society of Bengal, vol. ii., p. 397.

common in the granitic districts, and the conclusion of the eruptions by which the fossils were entombed ; but at present there is no proof of such having been the case ; and all observers have considered the eruptions to have been contemporaneous ; an opinion, to a certain extent, confirmed by the occurrence of the same fossils in very distant localities.

The sandstone and argillaceous limestone I have myself traced, from the neighbourhood of Nagpoor nearly to the junction of the Wurdah with the Godavery, bearing the same characters as in the vicinity of the fossil beds ; and I have collected specimens of the same rocks at various places between this and Badrachellum and the diamond mines in the neighbourhood of the Kistnah. This tract, for 250 miles, is nearly an uninterrupted forest, and presents many difficulties in the investigation of its geological structure. Trap rocks and basaltic soil occur in many parts of the course of the Godavery, and granite of the usual character is occasionally met with. Dr. Voysey, who investigated great part of it with his usual accuracy, describes the sandstone as constituting a range of mountains 60 miles in extent, to the north-west of Badrachellum ; and the surface rock 20 miles south of Ellore (near the alluvial plains of the Kistnah and the diamond mines), also at Mungapett on the Godavery, where I found silicified wood resembling that of Pondicherry*. Fossil wood was also seen by Mr. Geddes strewed over the country N.W. of this point, towards the junction with the Wurdah. Where the sandstone of the Godavery meets the granite to the west, Dr. Voysey states that it can hardly be recognised as the same rock, consisting of a conglomerate containing quartz, felspar, and rounded pieces of granite resembling that of the eastern ghàts. The argillaceous limestone occurs in the same district, and is more widely distributed than Dr. Voysey supposed. He found it at an elevation of 2600 feet above the sea, and exhibiting marks of great disturbance, dipping to the S.E., and at the summits of the hills intermixed with quartz rock†. Dr. Voysey considers these formations at the lower part of the Godavery, to be the same as those of the Kistnah and Pennar ; and in this opinion I fully coincide, although I have found the continuity of the sandstone and

* Journal of the Asiatic Society, vol. ii., p. 402. The tenor of Dr. Voysey's observations in this place seem to show that he considered the "clay slate," in which he included the sandstone, to belong to the same formation as the limestone ; a conclusion I had formed before meeting with his paper, and which has not been expressly stated in any of his writings yet given to the public.

† The structure of the wood is beautifully preserved : it is coniferous. June 24, 1839.

argillaceous limestone to be interrupted by a narrow band of granite, extending from the delta of the Kistnah to the granitic platform of the Deckan. Some of the hills, however, have caps of sandstone. In the present state of our knowledge, it is difficult to form any correct notion as to the dip and direction of these rocks. Indications of derangement and elevation by the granite are, however, sufficiently apparent.

Sandstones and schists of the same characters, and associated with the same rocks, are also extensively distributed along the great tributaries of the Kistnah, in the southern Mahratta country, near the western ghàts, and a little to the south of the part of the basaltic district described by Colonel Sykes (Geol. Trans., 2d Series, vol. IV.). The limits of this part of the formations have been but imperfectly traced. According to Dr. Christie's observations and my own, they are the same as those of the Cuddapah district*. The occurrence of sandstones and stratified limestones in this situation, is a fact of great importance, which has escaped the notice of those, who have speculated on the period of elevation of the great mountain chains of the peninsula. It was for this reason, that I selected the line of section from Madras to Atchera, on the western coast, within the limits assigned by Colonel Sykes to the basalt, and near to which I discovered the sandstone *below* the escarpment of the western ghàts. (Plate, Section 2). In the pagoda of the town, I observed several quartzose sandstone pillars; and I discovered the rock itself forming a small range of hills to the south of the town, and dipping at a considerable angle to the N.W. The stone is similar to that of the hills, near the Chinoor diamond mines. The rock at the entrance of the inlet is laterite, having the appearance of horizontal stratification; and there are some indications of trap below it; but of this I could not obtain positive evidence. Colonel Sykes, however, states that the basalt occurs a little to the south at Malwan; and I found it at Colter, and other places to the north, underlying the laterite, at the foot and on the escarpments of the hills. These facts are sufficient to show, that the elevation of the western ghàts in this part of their course, was posterior to the deposition of the sandstones, which, for the present, must be considered as contemporaneous over all the districts described. I am aware of the uncertain nature of mineralogical characters, as characterizing different formations; but in rocks exhibiting such remarkable appearances and relations over such extensive areas, and when no organic remains exist in them, I do not think it wrong, to place some confidence in the evidence they afford, more particularly in the south of India,

* Edinburgh New Philosophical Journal, 1828 and 1829.

where the rapid changes of formations, so common in Europe, are quite unknown.

The speculations of Elie de Beaumont on the age of these mountains is founded on negative evidence and analogies which appear to me to have little weight; nor can I consider the remarks of Dr. Benza, founded on his excellent researches on the geology of the Neilgherry mountains, as more conclusive. The non-occurrence of stratified rocks and of organic remains in a high granitic table land, affords no proof that these mountains have not been recently elevated; and the plentiful occurrence of ferruginous sandstone, containing brown coal, lignite, and mineral copal, at the foot of the Travancore mountains, show that these inferences have been too hastily drawn, when such gigantic generalizations were to be established.

Age of the Diamond Sandstone and Argillaceous Limestone.

With regard to the age of the diamond sandstone and argillaceous limestones, my own conviction is, that they belong to the more ancient secondary, or even transition rocks; an opinion, which is not at all contradicted by their frequent occurrence in horizontal strata, as they could not have been deposited in the situations in which they are now found. The facts I have stated, will enable others to estimate the correctness of an impression founded on the structure, geological relations, and occasional nearly vertical position of the strata. On this subject, I would express no decided opinion, but recommend an examination of the junction of these formations with the stratified and unstratified primary rocks, with a view to this question.

The sandstones and limestones of Bundlecund and Malwa correspond in many particulars with those of the south of India, and have been considered by all writers as belonging to the same formations. The sandstone, Major Franklin considers to be the same as the saliferous sandstone of England*; to which it has been objected, that the salt diffused through the soil of Bundlecund may not be derived from this source, as it has never been discovered in that rock. I have also ascertained that salt occurs in all the formations of India, from granite to recent alluvium. I have, indeed, never met with a saline spring in the sandstone, but this I consider to be accidental, that rock being generally placed in inaccessible situations. I have, however, found thin seams of salt, interstratified with the upper schistose layers of the argillaceous limestone, in the

* Geol. Trans., 2nd Series, vol. iii., Part I.

immediate neighbourhood of a cliff of sandstone 300 feet in height, between the lower beds of which a similar schist was interposed. A more important objection to Major Franklin's opinion of the diamond sandstones belonging to the new red sandstone is, that in the peninsula, this sandstone, throughout 800 miles of latitude, and half as much of longitude, is *superior* to the limestone he has called "Lias." Nor can I find sufficient proof in his memoirs, or in other papers on the country between the Nerbudda and the Ganges, that this limestone reposes directly on the sandstone; and it is evident, that no inference can be founded on its occurrence at a higher level in a country so much altered by denudation and the intrusion of eruptive rocks. But should it be hereafter found, that the limestone in certain parts of Bundlecund does actually occupy a higher geological position, the fact would not be conclusive against the diamond sandstones of the north and south, belonging (as every thing indicates) to the same formation. I am indeed of opinion, that the argillaceous limestone and the sandstone constitute only one formation, although I do not think that they should be spoken of as such in the present state of our knowledge. The basalt which has broken up and penetrated these rocks to the north and south of the Nerbudda, is connected with the same system of trap rocks, and was probably erupted at a period much more recent than either of those to which the sandstones and limestones have been referred.

Inferences respecting the Freshwater Fossils.

On the evidence on this subject afforded by the fossils imbedded in or covered by the basalt, I shall now make a few observations. For the descriptions of the shells, I am indebted to Mr. J. De Carle Sowerby*.

The e fossils all belong to freshwater genera, and to species which have not yet been discovered recent. I have not been able to obtain the seeds of Asiatic *Charæ,* nor the valves of any *Cypris* inhabiting the fresh waters of India. The shells, however, all differ from those inhabiting the rivers of the neighbouring country, as far as Mr. Sowerby and myself could judge, by comparing them with a collection of recent shells, which I made during a residence of several years at Nagpoor; nor do I think it possible that any of the larger shells could have escaped my notice, did they still inhabit the northern branches of the Godavery. Colonel Sykes, also, had the kindness to allow me to examine a collection of recent shells made by him near the western ghats, consisting of the same species as

* See Plate, and Description.

those of the Berar valley, and they are of course different from the fossils. I also failed to detect amongst them any of the shells contained in a large collection of recent land and freshwater Testacea from Bengal, presented to the Zoological Society by Mr. Benson. It may therefore be inferred, that the fossils do not belong to recent species.

Gyrogonites have not yet been observed in any deposit more ancient than the freshwater formations of the basin of Paris. Cyprides occur in the tertiary strata, and in the Weald clay below the chalk, and perhaps in the Birdiehouse limestone of the Edinburgh coal-field. Of the other five genera discovered in these fossil beds, two have hitherto been found only recent or in tertiary deposits, viz. *Limnea* and *Physa*; and the best characterized specimens of some of the others are referable to the same period. It is therefore extremely probable, that the basalt in which these fossils are imbedded, and which has altered the rocks in which they occur, belongs to the tertiary epoch; but to which period, I fear we have not the means of forming any decided opinion. Though none of the species are recent, yet they are too few and in too ruinous a state to admit of any general conclusions; although, from the very great number of individuals collected in various localities, without adding any fresh species, it is probable that nearly the whole which exist have been procured. But when the vast extent of the country occupied by the basalt is considered, and that a still greater tract was broken up or disturbed at the time of its eruption, it will not appear improbable, that a rule, founded on the disappearance of marine shells in districts exposed to no such extensive causes of destruction of animal life, should not apply.

In the preceding pages, I have described the fossils discovered by Mr. Geddes and myself in various parts of the Sichel mountains, and the Valley of Berar, extending through the great trap district for 140 miles; and I shall now shortly refer to other localities at great distances from each other, where the same fossils have been found in similar rocks, buried under the basalt.

Other Districts of India in which similar Freshwater Shells have been found.

Dr. Spilsbury discovered, eighteen miles from Jubalpoor, in an undulating plain studded with irregular masses of trap, blocks of "indurated clay," containing casts of fossil shells, for the most part siliceous, and resembling those discovered by Dr. Voysey in the Gawilghur range*. At

* Journal of the Asiatic Society of Bengal, vol. ii., p. 205.

Saugor, nearly 100 miles to the north-west, reversed shells, stated to be exactly the same as those of Jubalpoor, were discovered by Dr. Spry in a bed of limestone, entirely surrounded by an amphitheatre of trap hills, in which a lower range of compact sandstone is included*. This fossiliferous limestone is covered by 17 feet of basalt, and rests on a coarse siliceous grit, under which basalt is again met with. In the same neighbourhood fine specimens of silicified palms are found. Jubalpoor and Saugor are situated to the north of the Nerbudda, in the great Vindya range; and in the same district fossil bones of Mammalia occur in limestone capped by basalt. The drawings of the shells differ a little from each other†, but the fossils are stated to be the same; and, as far as Mr. Sowerby could judge, they do not differ from the *Physa Prinsepii*. The similarity was more obvious in other specimens left in India, and I have no doubt of their being the same. It is, however, desirable that the specimens themselves, in the Museum of the Asiatic Society of Bengal, should be compared, that the connexion of the northern and southern portions of the trap formation may be placed beyond a doubt. South of the Nerbudda, fossils are again met with in the mountainous country, north of the sources of the Taptee, at a place called Jirpah, near to which trap hills have broken through the sandstone. Dr. Voysey, in speaking of the heat of the steel furnaces of Neermul, notices the occurrence of an "indurated clay" containing fossils at this place, but he gives no further information regarding them‡. In a small specimen of this rock, Mr. Sowerby recognized the *Paludina Deccanensis*, and a portion of a larger shell, probably the *Physa Prinsepii;* and the matrix is the same as the fossiliferous "indurated clay" from Gawilghur; it also much resembles many of the varieties of chert in which the Berar fossils are found. The third range of hills has been described by Dr. Voysey under the name of the Gawilghur Mountains, and it forms a very remarkable feature in the physical geography of Central India. In this lofty basaltic range, Dr. Voysey discovered fossil shells, the situation of which he has accurately described§; but as his account of them, has been so far misunderstood, as to induce Mr. Conybeare to state that they occur in "lias-like beds‖," and Colonel Sykes in a recent

* Journal of the Asiatic Society, pp. 376, 639.

† Ibid., p. 583, Plate 20.

‡ Ibid., vol. i., p. 247.

§ Asiatic Researches, vol. xviii., p. 187.

‖ Report to the British Association, 1832.

deposit*, it is necessary to mention that they are found in mountains in great part composed of basalt resembling that of the Giant's Causeway, but containing, more frequently, crystals of olivine, of basaltic hornblende, and carbonate of lime. This rock passes into a wacké, having every variety of structure and induration known amongst trap rocks, or into what has been called stratified basalt, from the parallelism of its planes, " the summits of many of the ravines presenting a continued stratum for many thousand yards†."

Ascending from the Taptee river, Dr. Voysey‡ observed a group of basaltic columns, and near the summit of the flat table-land of Jillan, he entered a pass presenting a perpendicular section, above the road, of 30 feet, and below it, a rapid descent of between 40 and 50. The lower part of the section, as well as the pathway, is composed of wacké, and " lying on it, is a stratum of earthy clay of different degrees of induration, 20 yards in length and about 2 feet thick, containing a great number of entire and broken shells," which are much compressed, and do not effervesce with acids. Some of them completely commix with the matrix. This bed of clay possesses all the characters of a stratum, which Dr. Voysey says, seems to have been depressed by an overlying mass, 15 feet thick, of the nodular basalt or wacké so common in these hills. The vertical fissures, which are so " remarkable in trap rocks, are prolonged from both the upper and lower rocks, into the shelly stratum, although there is no intermixture of substance." The stone in which these fossils occur, is similar to that of Jirpah, and of many of the specimens from the Sichel range and the valley of Berar; and the casts and fragments of the shells resemble those of the Paludinæ and other shells of that district. Between these mountains and the Sichel hills, the great valley of Berar is included, but the two ranges closely correspond in the nature of the soil and rocks, and in their fossiliferous beds. They are not, however, exactly parallel; nor do I think, that we are justified in classing them with the Vindya range to the north of the Nerbudda, or with the range which separates the valley of that river from the valley of the Taptee.

It is evident, from the same fossils being found in all these ranges, several hundred miles distant from each other, and from the same secondary rocks being broken up and altered, that the basalt of which they are principally composed was, in part at least, erupted at the same time;

* Geol. Trans., 2d Series, vol. iv., p. 426.

† Dr. Voysey, Asiatic Researches, vol. xviii., p. 127.

‡ Asiatic Researches, vol. xviii., p. 192, and Journal of the Asiatic Society of Bengal, vol. ii., p. 304.

and that the western and eastern ghàts must have partaken in this great movement.

Shells, probably of the same genera, were also found by Dr. Voysey in the insulated basaltic hills of Medcondah* and Sivalingapah, which rest on the granite of the Deckan, south of the Godavery, and are probably connected with the southern part of the great trap district, and the hills of Bicknor Pett and Nugger shown in Section 1. The fossils are imbedded in the basalt, in a siliceous rock containing lime, and corresponding in specific gravity, chemical composition, and appearance to the fossiliferous cherts of the Nirmul Hills. Sivalingapah lies considerably to the west, but nearly in the same latitude as Nirmùl.

The only other locality where fossil shells have yet been discovered, within or near the great basaltic district, is five miles south of Rajahmundry, a large town on the Godavery, a little above the alluvial plains of its Delta†. They occur in some small hills ranging nearly W. and E., and composed of conglomerate and red sandstone supporting wacké, overlaid by limestone containing shells, which is again covered by basalt. The shells are in the best condition in the upper part of the limestone; of many only the impressions remain, but the oysters, which are the most abundant, are well preserved. The basalt and some specimens of the chert, jaspers, &c., from these hills, presented to me by Dr. Benza, resemble the varieties found with the freshwater shells of the Sichel range, and the hills in which they occur having the same direction, are probably connected with the eastern termination of that range. They are evidently associated with the sandstones of the diamond districts to the north of the Kistnah, and with the continuation of the eastern ghàts; thus confirming the opinion above expressed, of these mountains being of more modern elevation than is supposed by some geologists. It is impossible to separate the western ghàts from the eastern in any theory that can be formed, as they diverge from the same point, support the same table-lands and the same stratified rocks; and where these mountains meet at the Neilgherry Hills, the hornblende schist has been noticed by Dr. Benza to dip in opposite directions from the eastern and western mountains.

In the Journal of the Asiatic Society of Bengal, vol. iv., p. 565, and

* In a specimen of this chert in the Geological Society's Museum, I have found a gyrogonite of the same kind as those of Nirmul, and halves of a species of *Cypris* associated with shells. June 24, 1839.

† Dr. Benza on the Neilgherries, Journal of the Asiatic Society of Bengal, p. 435., Aug., 1835.

our Plate, fossil shells are figured, which bear considerable resemblance to some specimens of Unio from the Sichel Hills, but not sufficiently to identify them. They form part of the Dadapoor collection of Sub-Himalayan fossils, so ably investigated by Lieuts. Baker and Durand, and are stated by Mr. Prinsep, in a note, to be identical with specimens collected by Colonel Burney with the bones of the Mastodon, &c. in Ava. He adds, that they probably belong to the large and thick species of *Cyrena* noticed by Professor Buckland as occurring in a blue and marly clay near the locality of the fossil bones collected by Mr. Crawford (Geol. Trans., 2nd Series, vol. v.) ; but I found the specimens of these shells in the Society's collection, to differ both from those of the Sub-Himalayahs and of Central India.

Mr. Pentland, in the same volume of the Geological Transactions, makes the following observations on Indian tertiary deposits : " How far " the same formation may be prolonged in a southerly direction along the " peninsulas of Malacca and of Hindoostan it is impossible to say ; al- " though we possess proofs of its existence at Madras, where it contains " the same species of shells as on the Brahma-putra, and at Pondicherry, " where it envelopes the great masses of silicified wood found near that " city." (p. 394). The formation on which Madras stands is, however, erroneously referred to the tertiary epoch, being a recent alluvium, accumulated by the joint action of the rivers and breakers, and containing the same shells as now inhabit the mud of the salt-water inlets and sea-shore of the Carnatic.

With regard to the age of the silicified wood of Pondicherry, no facts have yet been ascertained which can justify any conclusion. It is, however, to be hoped, that a gentleman familiarly acquainted with the tertiary and volcanic rocks of Greece and Italy, will soon communicate positive information regarding the geological relations of the sandstones containing the silicified trees and the fossil shells*, the conical hollows, obsidians, and other indications of volcanic action said to exist in that neighbourhood.

Relative Age of the Laterite and Trap.

I shall conclude this paper by one or two remarks on the relative age of the Laterite and Trap. Dr. Babington† and Dr. Christie had observed this rock, both below and above the ghàts in the latitudes of Seringa-

* The shells I have seen differ from those of Central India.

† Geol. Trans., 1st Series, vol. v., p. 329.

patam and Goa, and I have traced it in the deep and narrow valleys of Coorg, at various heights, from the level of the sea to several thousand feet above it; but as in all those places it rests on syenite or other granitic rocks, from the decomposition of which, *in situ*, there is much reason to suppose that this remarkable formation is derived, no inference as to its age can be drawn from these facts. At Colter, however, and other places on the coast of the great basaltic district, it rests on the basalt, forming the summits of the hills, or an external layer over the trap which constitutes the body of the hill. This superposition is exhibited in ravines passing through the laterite, or where that rock has thinned off so much, that it can be separated from the basalt below, which has most commonly a stratified arrangement, often highly inclined and parallel to the precipitous face of the hill. It has also been observed above the ghâts, and in the table-land of the Deckan, between the Godavery and Manjera rivers, resting on basalt; it is therefore probable, that the trap has been protruded from below since the laterite assumed its present form. It would be improper, in this place, to enter into any details regarding a formation which extends over much of the Malay peninsula, Ceylon, the coasts of Coromandel and Malabar, and Central India. In different portions of these vast countries, several varieties of this rock are met with, well deserving of attention, yet its general character and composition is the same over 30 degrees of longitude and 20 of latitude, and nowhere is any proof to be found of its being of volcanic origin*, or the equivalent of certain European rocks, as supposed by Elie de Beaumont. Under the name of laterite, however, very different rocks have been included; such as the ferruginous clays and sandy beds underlying the alluvium of the Irawady, near Rangoon, and a ferruginous conglomerate now forming in many places from decomposed and reconsolidated laterite or syenite, and containing fragments of granite, and occasionally enveloping a recent land shell.

Besides these, a rock, apparently of igneous origin, has been occasionally confounded with laterite, and in the diamond districts is known to the natives by the same name as is applied to that rock in the Mysore. The thinner strata of the diamond sandstone of the Pennar have been observed to be bent in a remarkable manner by the intrusion of this rock; and in other instances it had apparently escaped in a semifluid state between the joints of the larger tables, carrying with it fragments of the sandstone, whose angles are so well defined, that I thought I could trace the very spot from which they had been broken off. Notwithstand-

* Calder, Asiatic Researches, vol. xviii. Conybeare, Report to British Association.

ing these appearances, the character of the rock differed so much from any varieties of basalt I had then seen in India, that I hesitated about referring it to the trap family, till I had seen varieties of a red wacké much resembling it, constituting part of the basaltic mountains of the island of Salsette. It is in a substance of this kind, interstratified with sandstone, that Tavernier describes the diamond mines of Beejapoor to have been worked in former times. The transitory nature of the political divisions of this part of India, and the decay or desertion of many towns and villages, have hitherto prevented the identification of these mines; but enough has been said to show the importance of caution in reasoning on individual facts, relative to one of the most singular and extensive formations anywhere to be found.

Note.

The freshwater shells described in the preceding pages, must have inhabited sheets of fresh water of which no traces can now be discovered, in the configuration of the mountainous tracts, in which they for the most part occur. No natural lakes exist in these districts, nor could shells have accumulated in such quantity in rivers similar to those which now intersect the country. It may, however, be supposed that the sandstone and limestone rocks of Berar had once a position similar to that which the same rocks now occupy in the basins of the Kistnah and Pennar. Voysey describes these rivers as passing through the Nulla-Mulla range by gaps or fissures " which have been produced by some great con- " vulsion, which at the same time that it formed the beds of these rivers, " gave passage to the accumulated waters of some vast lakes situated " near the outlets." " The tortuous course of the Kistnah is bounded " for upwards of 70 miles by lofty and precipitous banks, which in some " places rise 1000 feet above its level, the opposite sides of the chasm " corresponding in an exact manner. Ravines of this description are not " unfrequent all over the range, and the exact correspondence of their " salient and re-entering angles, together with the abruptness of their " origin, totally preclude the supposition of their being hollowed out " by the action of running water*." Such seems also to have been the case, where the Pennar passes through a narrow gorge in the Gundicottah sandstone hills. Through the upper part of its course, this river flows over a flat country covered with alluvial soil, at right angles to the hills; but it finds an exit

* Asiatic Researches, vol. xv., p. 123, 124.

through them, by a fracture in the wall which in former times had apparently dammed up its waters. The strata have been much disturbed, probably by the eruption of the basalt, which is seen at the foot of the sandstone hills on the opposite side of the valley, from which the Gundicottah range appears to have been separated. Plate, Section 2d. It should, however, be stated, that ravines formed in this sandstone, by the action of the streams now flowing in them, exhibit abrupt precipices, the opposite sides of which correspond to each other as Voysey has described.

The sections accompanying this paper were constructed by Captain Smith, of the Madras Engineers, F. R. S., from information contained in my notes made during several journeys in the lines represented, and from some published papers. The information is by no means complete, but, I believe, it will be found to be correct as far as it goes. In consequence of the great length of the lines to be represented, and the comparatively moderate height of the hills, it would have been impossible to have given the different formations of sufficient size to have been seen in a distinct manner without great distortion of the strata, had the whole distance been represented. Breaks, therefore, have been introduced, representing the continuance of the same rock for the number of miles specified in each instance. In the Baulpilly valley and in some other localities (Sect. 2) the summits of the hills are almost inaccessible, and it has consequently been impossible to represent them as they occur in the exact line of section. I have therefore been content to exhibit the strata as they occur at their bases, with the exception of a few of the hills which have been more carefully examined, and which correspond in appearance to those which are as yet unexplored.

Section 1st passes from the Bangnapilly diamond mines to the valley of the Nerbudda, with the view of connecting Section No. 1, across the peninsula, with a line running north and south through its centre ; and which might easily be continued to the Himalayah mountains to the north and Ceylon to the south.—*Transactions of the Geological Society of London, Second Series, vol. 5, part* 3, *pp*. 537-575.

VIII.—*On the Entomology of the Himalayas and of India.—By the* Rev F. W. Hope, F.R.S., F.L.S., *&c., President of the Entomological Society of London.**

It may by some be considered a proof of presumption, that any individual should undertake to describe the entomo-geographical character of a country which he has never visited; and bold, I am willing to allow, is the attempt to embrace, in my views, not only the distribution of Insects in the Himalayas, but those also of the whole Continent of India and its adjacent islands. Possessing, however, one of the richest Cabinets of Oriental Entomology to be found in this or any other country, the major part of the species collected at Calcutta, Madras, Poona, and Singapore, and in the islands of Java and Ceylon; and through the kindness of my friends, the late lamented General Hardwicke, Colonels Sykes and Whitehill, Captains Law, Smee, and Smith, having access to their rich and extensive collections from Nepal, Bombay, and the Deccan; I may be enabled, perhaps, from such a mass of materials, to offer some new facts respecting the geographical distribution of Insects, a subject apparently little studied, and certainly not sufficiently appreciated. It is, indeed, with diffidence that I undertake a task beset on all sides with difficulties; and before I enter on it, I claim the indulgence of my readers, and solicit them to regard the present attempt merely as an outline sketch, which can afterwards be filled up with greater accuracy, as our acquaintance with the nature of the soil, and the forms of animal and vegetable life belonging to the East, become better known. The entomological character of a country is particularly influenced by three things; first, by its temperature; secondly, by its vegetation; and, lastly, by its soil; and, perhaps, a few remarks on these subjects (relating chiefly to the Eastern world) may not here be deemed out of place, before entering more fully into the entomology of the Himalayas and of India.

* The Author has to apologize to the Rev. Mr. Hope and to his readers for the long delay which has occurred in the publishing of this valuable Paper, written for him in 1834, and which has been in type for a considerable time. The Insects of the Author's collection which Mr. Hope has described, were collected in the neighbourhood of Saharunpore, in the valleys of the Himalayas, and on the mountains in the neighbourhood of Mussooree, at 6,500 feet of an elevation in 30° of N. latitude. The reader will observe that many of the desiderata required by Mr. H. on temperature and vegetation, are detailed throughout the "Illustrations," and he cannot fail to be struck with the remarkable coincidence in opinion, respecting the distribution of Insects as given by Mr. Hope, with that of the Author on the geographical distribution of the Flora of the plains and mountains of India.—J. F. R.

INFLUENCE OF TEMPERATURE AND OF MOISTURE.

In those regions of the world where we find a multiplicity of genera of animals, united with a prolificness of species, we may naturally imagine that circumstances are admirably suited to their existence; and, on the contrary, where we find a small number of genera, and in many instances a diminutive form, and a paucity of individuals, we arrive at an opposite conclusion. Now, if we search for the cause of these discrepancies, we shall find it to depend in a great measure on the influence of temperature. Let us examine, then, in what portion of the globe a super-fecundity of organized life exists. Certainly not at the poles, or even in the temperate zones; to the tropical and equatorial regions we must next proceed, and it is there, in those warmer districts of the earth that we find the energies of life more early developed, and vigour and productiveness seem the characteristics of the clime. These remarks apply not less to animal than to vegetable life, for no where do the Herbivora abound more than in warm regions, and no where do we meet with more luxuriance of foliage, or a greater exuberance of arboreous vegetation, than within the tropics. As we recede from the equator, and approximate to the poles, temperature gradually diminishes; and probably nearly in the same proportion as heat decreases, so shall we find the decrease of animal and vegetable species, till we arrive at that degree of cold where vegetation is stunted, circulation languid, animation becomes suspended, and existence is scarcely tenable, if not actually destroyed.

To obviate the effects occasioned by a low temperature, some animals burrow in the earth, and pass the winter in inactivity and torpor; others again, gifted with extraordinary locomotive powers, migrate into milder regions in quest of food, which the rigour of a brumal season and a northern climate has rendered precarious. It appears to me an observation worthy of attention, that at the very period the migratory birds visit us, Insects are already teeming into life, while vegetation has arrived at a state of forwardness sufficient to support, as it were, the expected increase of animal beings. We infer, then, that as vegetation is apparently regulated and influenced by temperature, so animalization is in a measure dependent on vegetation as a secondary cause. It may naturally be expected, in a gigantic country like India, whose superficial area is nearly one million and a half of miles in extent, that great diversities of climate will be found; and when we take into our consideration the altitude of its mountains, surpassing in grandeur the Andes of the American world, we may expect every gradation of temperature which can occur, from the intense cold of the eternally snow-capped height, to the baneful heat of the tropical valley. The elevation of the land above the ocean, the

height and direction of its mountain ranges promoting or checking radiation, its mighty rivers and interminable jungles, its soil, strata, and arid deserts, absorbing and radiating heat, exert their varied influences, and modify the temperature of that extensive Continent; and yet, admitting thus much, I cannot help stating an opinion, that according to the extent of the country, no other portion of the globe enjoys a more general and equable uniformity of temperature than India. This may satisfactorily be proved, provided we take as the basis of our argument the wide range of region, over which not individual species, but whole genera of Insects extend, and the general uniformity of Oriental vegetation. Before dismissing the important subject of temperature, I wish to offer a few remarks on the variation of heat and cold throughout the summers and winters in the Himalayas and in India. In the former Dr. Royle states, in his admirable pages, that the Flora of the Himalayas in the spring and summer of the year resembles that of Europe, while in the rainy season it becomes intermixed with tropic-like vegetation; and hence there is a certain admixture of genera belonging to temperate and tropical climes. The change of temperature and of moisture producing a new vegetation, exercises a corresponding influence over the distribution of Insects throughout the same country; and consequently we have reason to expect, as will afterwards appear in my remarks, that its entomological character is also twofold, uniting in itself that of both zones. This intermingling of genera of tropical and temperate regions will ever probably be found more perceptible in the rainy season, in advancing from the valley to the mountain height; and perhaps we ought to know the results of the following researches, before we attempt to arrive at any conclusion respecting the distribution of animal groups in the Himalayas or in India. I would therefore suggest to future travellers in these magnificent regions, first, to endeavour to ascertain the differences of climate, and the causes which affect its temperature; secondly, to find out the average limit to which tropical forms extend, to state where they most abound, where begin to lessen, and finally terminate; thirdly, to note in what proportions the genera of tropical and temperate climes are intermingled; fourthly, at what altitude temperate forms predominate over tropical; and, lastly, to mention as nearly as it is possible the range of any group of animals in preference to that of any individual species: both objects, however, are desirable. In addition to the above desiderata, it will be necessary to note the seasons of Insects and times of their appearance, the soil in which they are found, and the vegetation upon which they live; since the distribution of animals in general is greatly dependent on food, which food will abound,

or be found deficient, according to the richness or poverty of the soil, or according as the degrees of heat and moisture influence the same. It appears to me, that it is chiefly in swamps, and in low and marshy lands acted on by the rays of the sun, where there is a union of heat and moisture, that the major part of Insects seem particularly to flourish. In such localities we find genera more abundant, a great increase of species, the number of individuals prodigiously augmented, and the energies of life more rapidly developed. Animals appear more than usually productive, either in the alluvium of mighty rivers, or in the tropical jungle. It was on the banks of the Nile, amid its slime, acted on by the influence of the sun, that the doctrine of spontaneous generation originated, and I am told also entertained by the ancient Brahmans on the banks of the Ganges, as seen in Susruta. It is in like situations, where heat and moisture predominate, that nature still exhibits her surpassing and inexhaustible fecundity.

If we next turn our attention to the tropical jungle, we meet there with nearly an equally teeming exuberance and productiveness of species. The heavy tropical rains saturating the accumulated mass of heated leaves, and vegetable matter, considerable vapour is produced peculiarly adapted to increase insect life; and it is not a little singular, that as soon as the first showers fall in these regions, all nature becomes reanimate; and as the rains increase, so do the Insects in proportion more and more, till the rainy season fairly sets in, at which period the jungle and the forest literally teem with myriads of insect population, more numerous than the stars of heaven, and as countless as the sands of the sea-shore. In concluding this part of my subject, I need only repeat shortly, that heat and moisture combined, exercise a powerful control over the geographical distribution of insect life, and that this distribution is also influenced in a greater or less degree by vegetation, as well as by the soil of a country; but these are subjects which require further elucidation.

INFLUENCE OF VEGETATION.

The entomologist who wishes for accurate information respecting the geographical distribution of Insects over the wide extent of our globe, must take into his consideration not only the influence of temperature, but that of vegetation; nor should he omit to note the varieties of soil which materially influence it. The dependence of this distribution of animals, although greatly swayed by temperature, is no less so by the supply of food and nourishment they can obtain. Insects are designated according to the kind of food they consume, as carnivorous or phy-

tyvorous; and in proportion as food is ample or deficient, so probably they abound in numbers, or decrease and vary in magnitude and form. To its abundance we may in some measure attribute size, to its deficiency the frequency of dwarfishness of stature, immaturity, and many of the numerous crippled specimens, as also some of the monstrosities found in our collections. The great Latreille has justly observed, that where the empire of Flora ends, there also terminates that of Zoology; and I have little doubt, that where vegetation is richest, there animal groups also will be found most abundant in genera, species, and individuals, not only those which are herbivorous, but those also which are carnivorous.

It is not my intention here to enter into any details respecting the Himalayan or Indian Flora. If the reader requires information on these points, I refer him at once to the accurate and invaluable pages of Dr. Wallich and Dr. Royle; and as I at present look merely to the vegetation, as influencing in a great measure the character of the entomology of the country, a concise outline of the leading features of the Botany of those regions is all that is here requisite. Throughout India, according to the above authorities, there appears to be an uniformity of vegetation, tropical species greatly predominating over those of the temperate zones; there occurs also a considerable admixture of genera belonging to temperate climes, and at a high elevation plants abound, which are indicative of Alpine regions. Several genera appear common to Europe, North America, and India; and in some instances identical species have been recognized as existing in Europe and in Asia, as well as in the New World. It still remains, however, with the botanist to determine the similarity of vegetation in Western India and Africa, a similarity which I anticipate will be eventually found to exist, if not at present actually known—a similarity I am led to suspect solely from observing a great resemblance in the character of the entomology of Western India and Eastern Africa.* In many instances cognate species of Insects appear both in Africa and Asia, which, by a careless observer, might be considered only as varieties; they are, however, on examination, sufficiently distinct, and I therefore think myself justified in esteeming them the representatives of their respective countries, as undoubtedly they fulfil the same offices and functions in both. In several cases we meet with identity of species in Asia and Africa; and there is an observation

* Vide p. 159 of the "Illustrations," where the similarity of vegetation in parts of India and in Western Africa is referred to, as originally remarked by Mr. Brown, and which has been confirmed by subsequent discoveries.—J. F. R.

I have made, worthy of still further investigation, that most of the Insects which are identical in both countries, are either coprophagous or phytyphagous; in short, vegetable feeders, which circumstance would lead one to suppose a similarity of vegetation in the different regions.

It may here be expected, perhaps, that I should state the relative proportions of the carnivorous and phytyvorous Insects; and I cannot but regret that I have not as yet followed up my investigations sufficiently to enable me to draw a satisfactory conclusion. Messrs. Kirby and Spence, in their interesting work, speaking of our British Fauna, esteem these groups as nearly equal in number. I must confess my own observation induces me to believe, that the latter greatly exceed the former in our own country. With respect to the phytyvorous group in tropical climates, they certainly greatly out-number the carnivorous; and were it not so, the air in those regions would scarcely be habitable, considering the nauseating effluvia arising from excrementous matter, which the Copridæ in particular tend to neutralise, by consuming, decomposing, and burying in the earth, all that is obnoxious and liable to putrify. In proof of this assertion, I will only here add, that five of the greatest groups with which we are acquainted, namely, the Lamellicornes, the Sternoxes, and the Longicornes, the Curculionidæ and Chrysomelidæ, are almost entirely phytyvorous or xylobious; and it may also be naturally inferred from the superabundance of animal life of all classes within the tropics, particularly the Ruminantia, that there also vegetation will be found most luxuriant; yet, looking to Insects only, we find they are scarcely sufficient to keep in check its excessive exuberance. In addition to multiplied forms of genera, we have an extraordinary increase of species and of individuals. It is in these same prolific regions also, that the mighty Goliathi and gigantic Prionidæ abound, where they perforate the trunks of the proudest monarchs of the forest, and hasten them onward to decay; and, by means apparently inefficient, check vegetation. It is time, however, to add a remark on the carnivorous Insects, which, although inferior in numbers to the phytyvorous, are still an important group; and in northern regions, by removing the decomposing matter from the decaying and putrifying carcass, fulfil the functions assigned to them by Providence. In tropical regions they are certainly not always so abundant, as a dead body, from the natural dryness of the air, and intense heat of the sun, is frequently dried up before putridity has made much progress; at least, such is the case in the Pampas. I cannot help thinking, however, although our cabinets contain but few species from equinoctial and tropical latitudes, that eventually they will be found more numerous, and that in these regions we shall still find them more proportioned to the excess of animal

life than appears to be the case at present. Religious prejudice, and the filthy and disgusting habits of these Insects, may be the causes why they have been neglected. In India, if the Necrophaga are not so numerous as elsewhere, yet the numbers of some particular species being excessive beyond measure, are sufficient, perhaps, to compensate for want of variety.

RANGE.

In the consideration of the geographical distribution of Insects, especial notice should be taken of the range over which genera and families extend. From want of attention to this subject, entomologists have not sufficient data to form any just views respecting it. Every naturalist who has studied animals, must be aware that certain tribes, genera, and species, are peculiar to particular regions of the globe. On the contrary, in various countries of the earth the Botanist meets with genera of plants which are common to Europe, and the other quarters of the globe, to the Old World as well as to the New. In some instances, identity of species has been recognized in countries remotely situated, between which seas and oceans intervene. It becomes, then, a question of considerable importance to determine if any species of plants have an unlimited or universal range, as probably all those insect races which feed on vegetables are regulated in their distribution by the same laws which govern the distribution of the plants themselves. It must be evident even to the most careless observer, that where the climate is materially changed in temperature, that there vegetation will be proportionately altered, and I imagine that eventually the entomological character of a country will be found much more dependent upon vegetation than has hitherto been allowed. It is true, indeed, that although two countries may agree in temperature and botanical character, the Insects may be totally different in form and appearance; but, in looking to their functions, if we find them the same, or nearly the same, we at once acknowledge the resemblance, and imagine they take the place of other known and existing groups elsewhere; a resemblance of character, which Messrs. Kirby and Spence have very properly denominated representation, which representation will even be more perceptible as the soil and general characters of the countries accord.

INFLUENCE OF SOIL.

Having already seen that both temperature and vegetation exercise a powerful control over the geographical distribution of insect races, there still remains a third subject of inquiry, namely, the influence of

soil over the same groups. If we find that in particular rich soils various genera of Insects abound, and that in others of an inferior quality scarcely a species can be met with, may we not naturally infer that there must be some peculiarity in it, and that the animal groups are influenced by their attachment to the same? The Botanist readily admits that vegetation is materially influenced by it, but as yet the Zoologist has made little inquiry respecting this subject, replete as it ever must be with high interest, and well worth most serious attention. Without entering deeply into the geology of India, I may state, on the authority of Colonel Sykes, that the character of the geology of great part of the Peninsula, like that of its vegetation, presents considerable uniformity: unacquainted with its leading features, I can derive my observations respecting it solely from the examination of the genera before me. I will, therefore, merely give concisely what groups attach themselves to particular soils in different countries, and hope that the attempt, imperfect as it is, may induce other naturalists to undertake an inquiry which must lead to very important results. As the mountain, the valley, and the plain, have their own peculiar temperature, vegetation, and soil, they have also particular groups of animals attached to them; and if we look more closely, we shall find that particular families and genera are always to be met with in certain strata and soils, evincing, as it were, a partiality and adaptation, by frequenting and thriving in them.

It may here be worth while to specify some of the genera of Insects attendant on the difference of soil. It is in the sandy districts of our own country that the few species of Cicindela, peculiar to our island, occur. Cicindela maritima, however, prefers the vicinity of the sea-shore, while several Oriental species, remarkable for their beauty and colouring, delight more in the alluvial soil of rivers Frequenting the sandy heath are found the splendid Chlorion, the fetid Sphex, and restless Ammophilus, associated with numerous species of Andrena and Nomada. In the sand, washed from the mountain height, at the sources of our European rivers, some species of Nebria and Psammodius are exceedingly abundant. If we visit the parched and burning sands of Africa, we there meet with the rapacious Anthia, the desert-loving Graphiptera, the burrowing Scarites, and countless species of Heteromera and Tetramera. In the same soil also, on the banks of rivers, the genera Epaphius and Trechus, Clivina and Dyschirius, are not unfrequent. On the sand of the sea-shore, Broschus, Bradytus, Pedinus, and Ægialia, occur in extraordinary numbers; and where it is habitually covered with salt water at the departure of the tide, we capture Cillenum, Pogonus, Hesperophilus, and Heterocerus, the singularly-formed Bledius, and wonderfully-abundant Ophonus

pubescens, all of which I have reason to believe can live submerged beneath the sea a considerable period. Of all other soils, *clay*,* being naturally cold, attracts fewer Insects, excepting the widely-disseminated Harpali. In gravel, occur the genera Opatrum, Halictus, Cerceris, with numerous colonies of Ants. To a chalky soil are attached the Ophoni, Licini, Chœtophora, and various species of Polyommata, Osmia spinulosa, and Andrena hæmorrhoidalis. When collecting in the mud of the fresh-water marsh, we capture Blethisa, Chlænius, Omaseus, and Agonum, and several Carabidæ. In the slime of brackish waters, several Notaphi are exceedingly abundant, though rare elsewhere; and in company with them we find the subaquatics Elophorus, Parnus, and springing Salda. It has also been observed, that Pimelia is only to be met with where the plants of the genus Salsola abound. Catascopus and Elaphrus frequent the alluvium of rivers. In the mud of lakes and pools various genera of Eupodina, Nothiophilus, Bembidiadæ, and Trechidæ occur; and in vegetable mould, where the grass is luxuriant, numerous Diptera, and Larvæ of Lepidoptera, abound. Even in this short and imperfect account of different genera attached to varieties of soil, sufficient has already been stated to prove that it exerts an important control over the range and distribution of Insect races: however, to give the naturalist a better insight into Indian groups, I shall here add an analysis of the leading families and genera which have fallen under my observation, and then conclude with an abstract describing the leading characters of Himalayan and Indian Entomology.

From what has already been written, it will appear that Insects, in their geographical distribution, are influenced by various causes; by temperature, by excess or deficiency of moisture, by the influence of vegetation, and by soil. There is yet, however, another, which materially affects, in some instances, particular groups, namely, the peculiarity of the organization of the Insects themselves. Should any genera of Insects occur which are deficient in the organs of locomotion, they would naturally be restricted to certain localities. How many genera of the Coleoptera and other orders are apterous, and are only found in particular situations; and they have necessarily particular functions to perform in their restricted limits, and also particular organs adapted to the work assigned them by the Creator. It is to the study then of the differences of organization adapted to differences of situation, and other external circumstances wherever we find Insects, that the entomologist should

* Mr. Shuckhard informs me, that Andrena labialis seems peculiarly attached to the London clay.

direct his attention. Contemplating all these instances of adaptation, we reverence the wisdom of a creative and the beneficence of a superintending Providence, that prevents diminution and increase, both extremes of which would prove injurious ; for without these " armies of the living God," to keep in check the fecundity of nature, plague and pestilence would walk abroad, and depopulate not a single country, or one quarter of the globe, but the whole earth itself.*

ANALYSIS

Of the ENTOMOLOGY of the HIMALAYAS and of INDIA.

CICINDELIDÆ.

The following genera belonging to this family are not uncommon in India, *viz.* Therates, Tricondyla, and Colliuris: the two former are characteristic of a southern range, while the latter is abundant throughout the eastern continent. Of Indian Cicindelidæ, more than sixty species have fallen under my notice: the most splendid of the race abound in Nepal. Among various species, however, peculiar to the Himalayas, only one approaches the form of our European Germanica.

DRYPTIDÆ.

As I am only acquainted with a single species of Indian Casnonia, I pass on to Drypta, a Nepalese individual of this family belonging to the genus Desera, Leach, which is described in General Hardwicke's collection. Five others are also recorded as inhabiting India.

LEBIADÆ.

Cymindis has not yet been discovered in India; eventually it may occur in the Himalayas: it is difficult to imagine what genus takes its place. Lebia is of rare occurrence in the East; a non-descript, named unicolor, in my collection, is from the Himalayas. Aploa is found at Poona. Orthogonius is common to Africa and Asia: the gigantic species, however, predominate in the latter country.

* In concluding my observations on the geographical distribution of Insects, I think it may be stated, that naturalists on this subject have almost exclusively directed their attention to temperature. Where temperature fails, we may turn to vegetation; and if the latter is not sufficient, then to the soil and strata of a country, and even to the organization of the Insects themselves, as well as other causes. No one by itself is sufficient to unravel the difficulties which arise; by uniting all, however, we may in a great measure account for the various discrepancies that occur.

BRACHINIDÆ.

The French writers appear unacquainted with the true type of Helluo, exclusively belonging to New Holland: the genus denomiuated Omphra by Dr. Leach, applies solely to the Indian Helluones. Ozæna and Pseudo-zæna inhabit Calcutta and Cayenne; while Trigonodactyla appears in Africa and Asia. The Graphipteræ of the sandy deserts have no representative in the East. This genus appears to unite Brachinus and Anthia: the latter is found throughout the continent of India. Some of the specimens from Nepal, however, are very diminutive. Aptinus is partly confined to Northern Europe and America; while true Brachinus enjoys the unlimited range of the world. Catascopus is found in Nepal, and resembles in its habits Elaphrus of Europe, and probably occupies its place. Dyscolus, Promecoptera, and Thyreopterus, prefer the southern tropical regions, and are not found to range as far north as the Himalayas.

SCRAITIDÆ.

Siagona atrata is met with in Nepal and various parts of India: a specimen lately received from Egypt, if not the self-same, is so exceedingly alike in size and sculpture, that it is very difficult to distinguish. The Scaritidæ abound in both hemispheres. Scapterus of India is represented by Oxystomus in the Brazils, and in Africa by Acanthoscelis. Morio and Clivina will, perhaps, be found in both the Old and New World; the latter, indeed, is common to all temperatures; the former may eventually occur in Europe, perhaps in Sicily.

HARPALIDÆ.

Harpali are found dispersed nearly in all the countries of the globe: they abound more in the arctic than antarctic regions. The following genera are recorded as belonging to India, *viz.* Harpalus, Platymetopus, Selenophorus, Cyclosomus, and many others. Some species of Ophonus from Bengal and Poona, closely resemble British species.

POGONIDÆ.

Some of the genera of this family are not confined to the temperate zones; the major part of them prefer the polar regions. Pogonus and Cardiaderus are met with in Asia and Africa; while Patrobus is apparently peculiar to Northern Europe and America.

CALATHIDÆ.

Dolichus has not yet been discovered in India: it is probable, how-

ever, that it will occur there. Pristonychus inhabits Nepal and Europe; while Calathus prefers a northern more than a southern climate.

FERONIADÆ.

Instead of finding Pœcilus in India, we meet with Trigonotoma, Catadromus, Lesticus, and Distrigus: most of them peculiar to that continent. Argutor antiqua occurs in the East; Omaseus and Platysma in Nepal; and Steropus in the vicinity of Poona. It is by mistake that Percus has been introduced among oriental genera. Cephalotes is found in Nepal and Australia: Stomis, Zabrus, and Pelorus prefer the temperature of Southern Europe. They may, however, be expected to appear in the Himalayas. Amara is captured in Japan; Antarctia and Masoreus are equally natives of Europe, Africa and Asia. Several nondescript species from the East, of the latter genus, are to be found in our English cabinets.

SPHODRIDÆ.

The genus Sphodrus occurs in Nepal, and the anomalous form of Mormolyce in Java and Singapore; which last has been ranged with this family, but appears to be sadly out of place, as it is most likely a subcortical feeder.

ANCHOMENIDÆ.

I am not aware that Platynus, Agonum, or Olistophus, have yet been discovered in India: the two former will no doubt be found in the Himalayas, when the Insects of that country are better known.

CALLISTIDÆ.

Epomis and Chlænius abound in the tropics: the maculated set appear common to Asia and Africa, each country possessing species almost exact representatives of each other. Chlænius nepalensis approaches in form to Licinus; and although Oodes is widely dispersed over India, no Nepalese examples have yet come under my notice. Callistus occurs in the Mysore.

DICŒLIDÆ.

Rembus is found on the Malabar and Coromandal coasts, at Calcutta, and in Nepal: its allied genus, Licinus, may be expected to occur, as some Asiatic species have already been described. Panagæus has its metropolis in India.

PROCERIDÆ.

Among the Insects collected by Dr. Wallich, there were four or five

species of true Carabus, only one of which I was enabled to describe. Several may occur in the colder mountain temperature, and it is probable they will resemble Siberian forms. Wherever the oak grows, there Calosoma will be found. Seven eastern species are known to me. C. indicum inhabits Nepal. If caterpillars are necessary to keep in check the luxuriance of tropical vegetation, surely the Calosomata are equally necessary to keep within bounds these Insects, which sometimes destroy, in northern climes, nearly the foliage of the year.

NEBRIADÆ.

This family may be considered as belonging to a Northern and Alpine range. Should it occur in Nepal, it will be found at a considerable elevation, possibly amid the Himalayan snows. As to Elaphrus, I have already stated an opinion that Catascopus represents it in India.

BEMBIDIIDÆ AND TRECHIDÆ.

Of the former family, several genera will no doubt eventually be found in Nepal: a single species of Tachys is the only example I am able to record at present. Of the latter, Stenolophus, Acupalpus and Tetragonoderus have occurred: the last of which may take the place of Bembidium.

DYTICIDÆ.

Aquatic Coleoptera are apparently not much influenced by climate: the temperature of water not varying like that of the earth or air, is the reason we meet with the self-same species in the interior of India and the south of France. Dyticus appears confined to Northern Europe or America, while Cybister is dispersed throughout the world. Eunectes and Hydaticus belong to Nepal and India, and to the latter country we may add also the following genera, *viz.* Colymbetes, Laccophilus, Noterus, Hyphydrus and Hydroporus.

GYRINIDÆ.

Many gigantic species of Gyrinidæ abound in India. Dineutus nepalensis, politus, and spinosus, have been found within the Himalayan districts.

HYDROPHILIDÆ.

Several genera of this family are as widely distributed as the Dyticidæ; and most of those found in India inhabit Nepal.

NECROPHAGA.

Differing with most entomologists, I am inclined to believe that the carrion feeders abound more in warm countries than is generally believed.

The religious prejudices of the Indians not allowing them to touch a dead body, may account for the few species which have hitherto reached Europe from the East. Necrophorus, Necrodes, Silpha, and Oiceoptoma, are met with in India and Nepal. It is probable that Necrophorus is more peculiarly adapted to Northern climates, while the remaining genera affect those of tropical regions.

EROTYLIDÆ.

Passing Nitidulidæ, which have been captured in India, we arrive at Engidæ and Erotylidæ. In the former family, we find Triplax, Ips, and Dacne; in the latter, Erotylus; and next to this group, Languiria and Eumorphus should be placed; genera abounding in species in Nepal and India.

DERMESTIDÆ.

In General Hardwicke 's Collection, there is a Nepalese specimen of Dermestes, similar in every respect to D. lardarius of Europe: a second species is closely allied to D. vulpinus of Africa. It is scarcely possible that either of them can have been imported into the Himalayas by commerce. This genus, and its congeners, is apparently a predominant group throughout the world.

BYRRHIDÆ.

The foreign Helocerata require attentive examination. Among the drawings of the Nepal Collection, made purposely for General Hardwicke, two species of Anthrenus are figured: they appear novel in form.

HISTERIDÆ.

This family abounds in India. I am acquainted with more than fifty species from the East: some of the Nepalese specimens are in too mutilated a state to describe.

LUCANIDÆ.

I formerly described six species from Nepal: two more from the Himalayas are undescribed in Dr. Royle's Collection. In no country is there a greater admixture of temperate and tropical forms than in India; some of the Lucanidæ resemble our British species very closely, while others are the same as those in Java and Singapore. Forty species have been submitted to my inspection. Passalidæ are not equally abundant in the Old as in the New World.

LAMELLICORNES.

The celebrated Ateuchus Ægyptiorum, or Sacred Beetle, has al-

most an exact representative in India. Gymnopleurus capicola, Hope, and azureus, Jab. both of them African species, are replaced in the East by G. sinuatus, Jab. and splendens, Hope. Sisyphus is met with in both hemispheres. Epirinus is an African, as well as an oriental form. Several Indian Copridæ resemble those of Egypt. Copris Midas of India and Nepal, exactly corresponds with C. Isidis of Africa. C. Sabæus and Pithecius appear common to both continents, and are equally abundant in Ceylon; and several smaller species of Copris, from the eastern part of Africa, if not the same, approach so closely to those of Western Asia, as to induce a belief that they are the same Insects, only modified by climate. Onitis and Oniticellus have also several representatives in both regions, if not in some instances the self-same species. Onthophagus abounds more in India than any other country; some of them unrivalled in size, splendour, and variety of form. More than 120 oriental species may be seen in European cabinets; five only now are described from Nepal; double that number, however, are in too mutilated a state to be characterized. Pactolus of Nepal and India, is represented in Senegal by Harpax, Jab. Aphodius, compared with Onthophagus, as an Indian group, is quite insignificant; scarcely twenty species are recorded, including those of Manilla and the Eastern Isles: a non-descript from Nepal will appear in the Appendix. As there is only a single specimen of Trox in General Hardwicke's collection, I pass on to

GEOTRUPIDÆ.

Geotrupes has been denied by Latreille to exist in India; the Baron de Jean also makes no mention of any Eastern species from that country in his last catalogue. Two species are in my recollection; one from Delhi, and a second from Japan; a third also, unique, is among Dr. Royle's Insects from the Himalayas. It is probable that this genus, when found in India, appears on mountains at a considerable elevation: the species also may be the common food of the Shrikes of that country, as they are in Europe, should those birds be found there. Orphnus, Athyreus, and Hybosorus, occur in India. Bolboceas appears in some measure to supply the place of Geotrupes, which last is not so important a group in the East, as in a northern region.

SCARABÆUS.

Under this term, the gigantic and most remarkable Insects of the Old World are ranged. Four species, allied to S. Atlas, Jab. are indigenous to Nepal, a convincing proof that equatorial forms extend beyond the

tropics, and that they are found in much colder temperature than is generally believed. There are several genera of Scarabæidæ, besides Oryctes, found on the Himalayas, as yet uncharacterized; some of them approaching African types.

MELOLONTHIDÆ.

Some of the Melolonthæ of Nepal are closely allied to our British M. vulgaris; others again, with the margins of the thorax serrated, evince their affinity to tropical species. Geniates, Apogonia, &c. are common to the Himalayas, the whole continent of India, and the Southern Isles.

MIMELÆ AND EUCHLORA.

These genera appear peculiar to the East: in a monograph, read before the Entomological Society, there are thirteen Mimelæ described; several from Nepal. Euchlora appears wherever Mimela ranges, and is more abundant in species.

POPILLIA.

This genus appears nearly equally abundant in Asia and Africa, and is common to the Old and New World. Fourteen species have been collected in Nepal. The following genera of Melolonthidæ, also, *viz.* Anomala, Hoplia, Apogonia, and Adoretus, occur in the same territories.

TRICHIIDÆ.

Acanthurus, Trichius, and Dicronocephalus, inhabit the Himalayas. The first of these forms approaches our European type, the latter is the representative in India of what Goliathus is in Africa, and Incas in Southern America. Goliatidæ is a conspicuous family, and may justly be ranked among the most extraordinary forms of the Insect world.

CETONIADÆ.

Although I described seventeen species from Nepal, Dr. Royle's collection appears to contain at least six more, entirely new. Campsiura xanthorhina, Hope, is represented in Africa by Cetonia scutellata, Jab. C. cornuta, Jab. is found in Africa, as well as Asia. I am acquainted with more than 111 species from India, and from this surprising number still likely to be greatly increased, it is evident that the metropolis of Cetoniadæ is situated in the tropical regions.

BUPRESTIDÆ.

Of this superb and extensive family, comprising at present more than one thousand species, existing in the cabinets of Europe, the most magnificent inhabit India; the splendid Sternocera and giant Catoxantha

range the Equator and the Tropics. Ninety species belong to the continent of India, many to Nepal, the isles of Java and Sumatra: among them are forms of temperate as well as of northern climes.

ELATERIDÆ.

This family persents us with types of form belonging both to the tropical and temperate regions: the former, however, are few in number, when compared with the latter. Several of the Nepalese Elateridæ resemble our British species, some so closely as to induce one to imagine that difference of climate is the cause of variety of the species. Elater murinus, Jab. of England, is well represented in Nepal by Elater cœnosus, *Hope*; and various species, which in Europe frequent the oak, alder, and willow, have Nepalese species nearly resembling them, and we have stated that there is a correspondence of vegetation between Europe and the Himalayas.

LAMPYRIDÆ.

Passing the Cebrionidæ, few examples of which occur in India, we arrive at the Lampyridæ; and justly may the East boast of its numerous and fine species, unsurpassed probably by those of South America. The warm damp of the jungle is peculiarly adapted to the habits of this family. Lycus and Omalysus, as well as Lampyris, abound in the Himalayan range.

MALACODERMATA.

By some writers, the families composing this group are considered rare within the Tropics, and they certainly are more abundant in Nepal than Central India; and yet they are not of rare occurrence. Anisotelus, Hope, appears to be peculiar to the East. Several species of Malachius and Melyris enjoy an Asiatic and African clime.

CLERIDÆ.

By the family Cleridæ abounding in the East, we arrive at the Ptinidæ; they, the latter probably, exist in Nepal; none, however, I believe, have yet been discovered in India, the nearest locality where they are found being the Mauritius. The Bostrichidæ are, however, abundant, and it is not unlikely that the Paussidæ commence where the Ptinidæ terminate.

CURCULIONIDÆ.

Without entering at large into the geographical range of the numerous genera of this family, I briefly state, that Nepal contains many tropical

forms, as well as others, which are peculiar to temperate climes, some of them extending from the Himalayas, even to New Holland, particularly Sipalus.

PRIONIDÆ.

By the Cucujidæ (common to India and Nepal) we arrive at the Longicornes. Prionus loves the torrid and tropical zones; some of the Himalayan species indicate an alliance to European types.

LAMIADÆ.

The largest, as well as the most beautiful species of this family, are found in Nepal. Lamia Roylii, Hope, is unrivalled in size; and L. Wallichii surpasses all others in beauty and colouring; it is found in Nepal, Japan, at Singapore, and the Isle of Java. Cerambyx, Callidium, Clytus, and Saperda, are predominant groups, and are found in all countries and climates. Many Nepalese species exactly represent our European types.

SAGRIDÆ.

Omitting Lepturidæ, confined almost entirely to Northern Europe and America, we arrive at Sagridæ. Donacia occurs in Java, and we may expect to meet with it in Nepal, and other parts of India; if not, it is probable that Sagra takes the place which Donacia does in northern regions. Several species of this genus are found on the Nympheacæ. I am doubtful if Sagra attaches itself to peculiar water-plants, or frequents the same as the former genus. Megalopus is found in Nepal, in Africa, as well as South America. Crioceris also appears to be a predominant group, while Adorium is confined more to Asia than Africa.

GALLERUCIDÆ.

Galleruca and Auchenia abound in Nepal, Halticæ are found throughout the world, and are intended probably to keep in check particular vegetation. In Europe, the genera Brassica and Sinapis almost annually suffer from their depredations; they appear to abound more in light and sandy soils; and where lime is used instead of animal manure, the crops are less attacked.

CHRYSOMELIDÆ.

Many of the Nepalese species resemble those of Siberia; others approximate closely to our European forms, so much so, that in many instances they appear like one and the self-same Insect; and if not the same, they are certainly similar representatives of their respective coun-

tries, and probably fulfil the same offices and functions. Podontia and Phyllocharis seem peculiar to Asia and New Holland.

EUMOLPIDÆ.

The Eumolpidæ of India are not surpassed in beauty or splendour by those of South America: they seldom, however, equal the latter in size. Clythra and Cryptocephalus occur in the East, both of them abounding more in temperate than tropical countries; in Dr. Royle's collection there are found several undescribed species from the Himalayas.

CASSIDIDÆ.

About fifty species of Indian Cassida have come under my notice; some of the Nepalese species resemble our English specimens, and may be parasitic on the thistle, as they are with us.

COCCINELLIDÆ.

Although I described twenty new species from General Hardwicke's collection of Nepal Insects, I find five others undescribed in Dr. Royle's collection from the Himalayas. Coccinella 7-puncata, Fab., appears common to Europe and Asia; at least the specimens agree so exactly in every respect, that after a very accurate examination, no important difference can be found; and believing them to be the same, I still cannot imagine that they have been imported into India by commerce. Endomychus may eventually be expected to occur in Nepal.

HISPIDÆ.

Hispa erinacea is abundant in Nepal; and two undescribed species are in Dr. Royle's collection from the same country.

TENEBRIONIDÆ.

The transition from Hispidæ to the present family by means of Sarrotrium is rendered easy. Hegeter and Tagenia, common to India, appear to follow in successive order. Both Upis and Tenebris are found in the Himalayas, and are abundant in the Tropics.

PIMELIARIÆ.

Pimelia has not yet been described as existing in India; last year I received two species from the vicinity of Poona. Sepidium, Blaps, Eurynotus, and Opatrum, occur in the East; the first prefers the Southern Tropic; the two next appear at Bombay, Calcutta, and Nepal; and the last is widely dispersed throughout the East. Passing Diaperidæ and

Cossyphus, both of them common to Asia and Africa, we next meet with Cistela and Lagria: the latter apparently a predominant group. Pyrochroa, also, has been discovered in Java.

HELOPIDÆ.

This family is the grand receptacle for the various forms of Heteromera. Among the Indian genera we find Amarygmus, Cnodulon, and Platycrepis, with several true Helopidæ, rivalling in splendour and magnitude those of the South American Continent.

MORDELLIDÆ.

Most of these Insects are parasites of the Hymenoptera, and abound in tropical climates. Their office is probably to keep in check, and prevent the too rapid increase of Vespidæ and Bombidæ: they are common to the Old and New World.

CANTHARIDÆ.

The geographical distribution of this family is particularly interesting, as it contains those Insects which are used in Medicine, and denominated Blister Flies. Lytta gigas, Fab., is found abundantly in India, and also in Senegal; and there is little doubt that several species of Mylabris will be found common to both continents. These vesicatory Insects of the Old World are replaced in the New by the genus Tetraonyx.

STAPHILINIDÆ.

By the families Notoxidæ and Scydmænidæ, we arrive at the Pselaphidæ, and afterwards at the Brachelytra, which terminate the Coleoptera. Anthilephila and Notoxus occur in Nepal, and Scydmænus in Java; while various other genera of Staphilinidæ are widely dispersed throughout the East.

ON THE REMAINING ORDERS.

Having entered fully into the consideration of Eastern Coleoptera, it is not my intention at present to go into lengthened details of the remaining Orders. It is sufficient to state, that in all of them there will be found similar and corresponding characters as in the Coléoptera. With regard to identity of species, I cannot help remarking, that of Lepidoptera, there appear to be a much greater number of species, widely disseminated throughout the world, than of any other Order. In Asia and Europe we meet with Papilio Machaon, Gonepteryx Rhamni; with some species of Colias and Pontia, with Vanessa Atalanta, and Cynthia Cardui; and to these might be added, several identical Sphingidæ, particularly Acherontia, Atropos, Deilephila, Celerio, and Sphynx. Among

the Noctuidæ, Geometridæ, Tortricidæ, and Tineidæ, many species will also be found inhabitants of both continents. In the Orthoptera, some Gryllidæ are common to countries remotely situated, which may partly be accounted for by the migratory habits of these Insects; and the same remarks may be applied to the Sphingidæ. Among the Blattidæ, several tropical species range widely; some of them have become naturalized even in a northern climate; and it is no uncommon occurrence to find Indian, Brazilian, and New Holland, species in a high state of perfection alive in the houses of London; and among the Eastern Neuroptera, there occur various Libellulinæ and Hemerobeidæ, closely resembling our English species.

Among the Hymenoptera, may be noticed the universal ranger, Evania appendigaster, ever attendant on Blatta; some Icheumonidæ, Crabronidæ, Apidæ, and Vespidæ, all of them presenting identical species with those of our own country. In referring to the Diptera, I need only mention the wide range of the Orange Fly, the same in England, India, and America; the Gnats and Mosquitoes, common to the four quarters of the globe, alike the pest of the Indian and Laplander; and, lastly, various species of Musca, as widely dispersed as the half-domesticated sparrow of Great Britain. Passing by the Aptera, and the various parasites of birds, quadrupeds, and of man himself, we shall find also among the Hemiptera, several identical species of Pentatoma, Reduvius, Tetyra, besides Cimez lectularius, the scourge of all countries and climates. It does appear, then, from the above Analysis, that Asia and Europe have many Insects in common, and probably other parts of the world will eventually be found to present not only similar genera and representatives, but also the same identical species, subject to the modifications of climate, and other external circumstances.

CHARACTER OF HIMALAYAN ENTOMOLOGY.

The character of Himalayan Entomology is twofold, Asiatic and European; and the intermingling of forms of temperate and tropical climes is one of its most distinguishing peculiarities. In its valleys (probably influenced by the heat and moisture of the jungle) southern forms predominate over northern; and it is not unlikely, that to the uninterrupted belts of jungle stretching along the mountain ranges, we may partly trace several tropical phytyvorous genera far beyond their apparent natural limits. Some carnivorous Insects are also found ranging far to the north in the Himalayas; an example of which is Anthia 6-guttata, a well-known

native of the Tropics : the specimens, however, are mere dwarfs, compared with those of Peninsular India, a fact which may be regarded as a proof, that Anthia has here reached its extreme limits, and consequently will soon disappear (as is the case) and be represented by another type, fulfilling the same functions, only under a difference of form. The following genera of Himalayan Insects, selected from many others, will evince their tropical relationship. Among the Cicindelidæ, Colliuris appears; among the Carabidæ, we find Desera, Omphra, and Cyclosomus; among the Lamellicornes, Euchlora, Mimela, and Dicronocephalus; and to these may be added, Anisotelus belonging to Telephoridæ, and Podontia and Phyllocharis to the Chrysomelidæ: all of them attached to warm countries, and some, indeed, are seldom found but within the Torrid Zone. It is needless to state many genera from the Himalayas evincing an affinity to European types;* some few, however, are worth noticing, such as Broschus and true Carabus, Geotrupes and Pimelia: the two last have been declared by high authority never to be found in India. Regarding identity of Insects occurring in the Himalayas, as well as in Europe, there are several species of the following genera of Coleoptera, namely, Elater, Melolontha, Chrysomela, Cassida, and Coccinella, which I cannot help thinking are the same as those of England; particularly as the vegetation of the two countries greatly coincide, for in very many cases, genera, and in some instances the self-same species of plants have been recognized. Among the carnivorous Insects, I believe that Dermestes lardarius, and vulpinus, Corynetes violaceus, and rufipes, and some of the Staphilinidæ, are essentially the same in Europe and the Himalayas. Of Lepidoptera, I figure Papilio Machaon, because it is evidently the same as what we meet with in England; the same remark will apply to Vanessa Atalanta, and Cynthia Cardui. The French entomologists are inclined to regard the Insects of widely separated countries as distinct species; I wish to esteem them as varieties, and I cannot help thinking, that as identity of Plants has been satisfactorily proved by Dr. Royle, so also we may believe in the identity of Insects in regions widely removed from each other. At any rate, should these varieties eventually prove distinct (which may be ascertained, I think, in the Lepidoptera order, when we become better acquainted with the oval, larval, and chrysalidous stages), yet the

* I may here add, that various Himalayan genera closely approximate Siberian forms, and that some of the species described by Dr. Gebler from the Altaic chain of mountains, particularly some Chrysomelidæ, I believe to be indigenous in both regions.

differences will ever be so slight, that we cannot separate or distinguish them in the imago state with any degree of certainty. But whether they be accounted species, or only varieties, we see the grand object of their creation, in their fitness for performing certain functions which are assigned them; one of these is, to keep in check the luxuriance of vegetation and to restrain it within due limits; another may be, that these puny agents may fecundate the flowers, by carrying the fertilizing pollen from tree to tree, and thus be the means, in one case, of promoting vegetation, as in another they are the agents of its destruction.

ENTOMOLOGICAL CHARACTER OF INDIA.

From the foregoing Analysis, I have no hesitation in asserting that the pervading character of Indian Entomology is uniformity. It is true that we meet with numerous genera, both of tropical and temperate climes, associated together; the former more abundant, the latter less frequent (as we might naturally expect) than in the Himayalas. There is, however, a greater intermingling of forms than at first sight would be readily imagined; but when we take into our consideration, that many of the species resembling those of Europe may have been captured on the mountain ranges, at a considerable elevation, we may partly account for it. This attempted explanation, however, is not always available or satisfactory; for in the heated valleys of the East, we find many European types and species, in numbers sufficient to excite our astonishment. It will appear, then, that many species taken in temperate and northern climes, are not confined to them, and that the range they enjoy is very considerable, extending not only over the Old World, but also to the New. As we advance from the Poles to the Equator, vegetation is more luxuriant, in proportion as heat increases, and the quantity of work assigned to Insect races is proportionately increased. Is it not natural to imagine that the functions performed by them in a colder climate, would in a warmer one require increased exertion and capabilities? It does not follow, because we find new types of form in tropical countries, and new genera of superior bulk and power, and more abundant in individuals, that therefore they necessarily replace the old ones, and are to perform the duties peculiar to both regions; both may live and thrive together, and abound in the same countries, and will eventually be found to do so. When the genera of temperate climes appear within the Tropics, I see no reason why they may not have the same functions assigned them there, as in colder latitudes; but when we find new types of form, and a more powerful organization, with the size of the Insects greatly increased (as

is the case in tropical regions), does it not almost naturally follow that they are intended solely for those regions, and for the increase of work they are there destined to perform? To return, however, to the subject of uniformity of entomological character throughout the Peninsula and the East, I think it probable that it is in a great measure to be accounted for by the general uniformity of its temperature, vegetation, and soil; there may, indeed, be other causes, which particularly influence it, but these may be esteemed the most essential. When we look to the range which genera here enjoy, it is very considerable: in part of the Himalayas, at the extreme southern points of India, in the West, and even in its Eastern Isles, there is one pervading character, evincing every where the prevalence of tropical genera. To speak more specifically, in Nepal and the southernmost extremity of the Mysore, and in Ceylon, at Bombay, and at Madras, at Calcutta and Singapore, in Japan and Java, with the rest of the Polynesian Isles, the majority of the same types abound; and what is of more consequence, a great majority of the same species also occur in most of the above-mentioned regions. Having noticed the intermingling of genera belonging to Europe and Asia, we may probably find a slight accordance elsewhere. Now, if we turn our eyes to Africa, we shall there find a considerable similarity in the entomology of this quarter of the globe with that of Asia; and this resemblance between the two countries will be readily seen by the short annexed list of some of the more particular genera, which are common to both of them. Among the Carabidæ occur Anthia, Orthogonius, Trigonodactyla, and Siagona. Among the Lamellicornes, Epirinus and Popillia, the conical Buprestidæ and the extraordinary Paussidæ, which last are chiefly found only in these regions; and to these may be added, as well as many more, the genera Melyris, Megalopus, Sagra, and Adorium; Dorylus, among the Hymenoptera, and Diopsis among the Diptera. Passing from genera to species, we shall find that precisely the same occur in both continents; among the most conspicuous, I shall mention but a few, namely, Copris Midas, Sabæus, and Pithecius, Cetonia cornuta, and Lytta gigas. Even supposing that no identical species occurred, which were common to Asia and Africa, yet we could not help observing the very remarkable similarity in the representatives of each; one example of which is, Ateuchus sanctus, which very closely resembles the celebrated Sacred Beetle of the Egyptians, the object of their worship, by some regarded as an emblem of fertility, but I think more probably that of eternity. Before concluding my remarks on the similarity of Insects found in Asia and Africa, I cannot help expressing a wish that some individual may be induced to develope the character of the entomology of these gi-

gantic regions more thoroughly than has yet been attempted; or there is an ample field for research and speculation. We shall feel much indebted to him, if he will explain how the Copridæ were transported from one country to another, and how they reached the island of Ceylon; how also Cetonia cornuta, which is taken on the banks of the Gambia, became an inhabitant of India. Lytta gigas may have travelled by land, and perhaps the Copridæ following the track and droppings of the camel, may have pursued the same route. Let him describe the sands of the desert and those in the vicinity of the Indus, give us a comparative Fauna of the Ganges and the Nile, record the varieties of temperature, the character of vegetation, and the genera peculiar to the different soils. Let him do this, following the steps of the celebrated Forskal, and he indeed will advance the objects of science, deserve the thanks of the present generation, and command the respect of posterity.*

Descriptions of Insects, *by* J. O. Westwood, Esq., F.L.S.

ORDER DERMAPTERA LEACH.

Family Forficulidæ.

Forficula Macropyga, Westw.

Piceo-nigra, punctata, abdomine æneo submicante, marginibus thoracis, tegminibusque rufescentibus, forcipe (♂) longissimo valde curvato, et gracili; (♀) fere recto tenuissimo.

Long. Corp. (forcipe excluso) ♂ lin. 6 ♀ lin. 5.

Ad genus Forficulam (stricte sic dictum Servilleo) appertinet, statura fere Forficulæ auriculariæ et paullo robustior, caput nigrum punctatum, impressionibus duabus anticis inter oculos. Antennæ ♀ (♂ mutilatæ) 13-articulatæ graciles rufescentes, articulis bassalibus obscurioribus.—*Prothorax* planus antice vix emarginatus, lateribus antice rectis, postice rotundatis, niger punctatus, margine tenui rufescenti; foveolis duabus rotundatis, antice impressus.—*Tegmina* piceo-refescentia, punctata, portio alarum detecta concolor. *Abdomen*

* By pursuing the course recommended by Mr. Hope, a naturalist would be enabled, not only to display the connection between soil, temperature, and vegetation, as well as the animal forms which the latter supports, but also prove the advantages of studying the natural sciences in connection with each other, and be enabled to explain something of the laws which influence the geographical distribution of plants and animals.—J. F. R.

nigro-picum punctatum æneo submicans; segmento penultimo lateraliter et angulariter producto (♂) aut simplici (♀). Forceps (♂) niger valde elongatus, gracilis ad basin, valde externè curvatus, in medio, dentibus duobus parvis internis instructus, apice sursum et exterius producto, acuto (♀) elongatus multo gracilior, rufescens fere rectus et inermis.

ORDER LEPIDOPTERA LINN.

DIURNA. Family Papilionidæ.

Papilio Machaon, Linn.

This handsome butterfly, like Vanessæ Antiopa, and Atalanta, Cynthia Cardui, and some others, affords an instance of wide geographical range,* rather than of representative structure, since the individual figured cannot be regarded as specifically distinct from the European specimens, which differ amongst themselves in various slight particulars, as the size of the dark bars, and spots, &c. It may, however, be noticed, that the specimen figured has the small oval black spot near the extremity of the anterior wings almost entirely isolated, the large basal black portion of the same wings is very strongly covered with yellow powder, whilst the black lunules of the posterior wings are not nearly so much powdered with blue bloom, as in the ordinary English specimens.

Fam. Nymphalidæ.

Paphia Parakekta, Horsfield. Lepidopt. Javanica.

Paph. alis anticis ad apicem acutis, posticis subcaudatis; anticis supra ad basin cæruleis, fascia obliqua lata fulva in medio, apiceque nigro; maculisque duabus parvis albis (una discoidali, altera apicali) ornatis; posticis cæruleis.

The preceding characters, drawn from the upper surface of the wings of this remarkable butterfly, will suffice for its determination until the publication of Dr. Horsfield's description. The under surface of the wings are, however, much more remarkable, bearing a most striking resemblance to a pale dried leaf; the deception being much increased by the form of the wings, when brought in contact by the Insect, whilst sitting upon a flower in the sun-shine, the short caudal appendages

* Messrs. Godart and Latreille, in the Encyclopédie Méthodique (vol. IX., Art. Papillon) state, that Pap. Machaon is found in Syria and Egypt.

giving rise to the idea of the stalk of the leaf, thus completing the delusion.

DIVISION ?———? Fam. Zygænidæ ?

Genus Campylotes, Westw.

Genus anomalum Heleonæ et Anthonoyzæ *Sw.* Gymnanto ceræque *Guér*, affine, alæ oblongæ, subovales, integræ, nervis apicalibus valde curvatis, anticæ cellula discoidali clausa nervos duos postice emittens, quorum exterior trifurcatis, posticæ etiam cellula discoidali clausà, nervo recurrente intermedio bifurcato. Corpus parvum abdomine gracili, pone alas haud protenso. Caput parvum. Ocelli 2. Antennæ graciles biramosæ. Palpi brevissimi supra haud discernendi, maxillæ elongatæ spirales.

Campylotes histrionicus, Westw. Æneus, alis ad costam rufo—, interne flavo-lineatis, maculisque apicalibus albis.

Long. Corp. lin. 11. Expans. alar. unc. 3. Habitat in Nepalia. Hardwicke ; in Montibus Himalayanis, Royle.

Corpus nigro-æneum, palagris maculisque abdominalibus lateralibus flavis. Alæ anticæ æneæ, costa, fasciisque duabus discoidalibus rufis, fasciiüsque tribus internis per totam longitudinem alarum currentibus flavis ; maculis 8 vel 9 (spatium inter nervos apicales occupantibus) albis. Alæ posticæ similiter coloratæ, at maculæ terminales flavo ornantur.

This remarkable Insect appears to be the extreme type of a very numerous Indian group of Lepidoptera, to which belong the species named Capys pectinicornis, Thallo, and Rhodope. It is impossible to decide upon their real affinities, until we obtain a knowledge of the metamorphoses of some of the species.

ORDER ORTHOPTERA. Fam. Mantidæ.

Mantis Roylii. Hope, MSS.

ORDER HYMENOPTERA. Section Pupivora.

Fam. Chalcididæ.

Dirhinus Himalayanus, Westw.

Niger, pedibus 4 anterioribus, tarsisque posticis rufescentibus.

Capite obtuse bicornuto.

Habitat in Himalaya.

Long. corp. lin. 2. Exp. alar. lin. 3.

Caput nigrum punctatum, anticé obtusé bicornutum antennarum arti-

culo primo nigro (articulis reliquis deteritis). Thorax fortiter punctatus; metathorace 4 lineato et ad latera, angulariter producto. Abdomen breve depressum thoracis latitudine. Pedes 4 anteriores rufescentes, 2 postici nigri, tarsis solummodo rufescentibus.

Obs. In hac specie partes oris valde elongatæ, labro oblongo-ovali ciliato, mandibulis inter se similibus, gracilibus, sub apice dente interno unico armatis.

ORDER HETEROPTERA. Section Longilabres.

Fam. Scutelleridæ,

Scutellera Pulchella, Hope, MSS.

Cæruleo-nigra vel-æneo, nitida prothoracis disco anticé, et margine postico æneo vel cupreo tincto, scutello aureo viridique intenti, fascia transversa basali, alteraque centrali obliqua, (in medio interrupta) et maculis tribus rotundatis (postice et in triangulum positis) cæruleo-nigris.

Statura fere Scutelleræ mauræ at paullo minor, scutelloque abdomen omnino obtegenti. Scutelleræ Stockeri affinis at robustior. Antennæ articulis duobus basalibus brevibus equalibus. 3tio. 2do. fere duplo longiori, ultimo omnium longissimo.

Long. corp. lin. 5. lat. lin. 3.

Fam. Pentatomidæ.

Megarhynchus Transversalis, Westw.

Fusco-niger, capite acuté bicornuto, angulisque anticis thoracis acuté antice productis, prothorace et scutello transverse striatis, parte coriacea hemelytrorum nigrâ, tenuissime punctata, membranâ apicali albida, antennæ et pedes nigri.

Long. corp. lin. 7½. lat. lin. 3½.

ORDER HOMOPTERA. Section Saltatoria.

Fam. Acadidæ.

Cicada Sulphurea, Hope, MSS.

Nigra, capite thoraceque sulphureo maculatis, alarum dimidio basali sulphureo, parte anticarum sulphurea, fascia obliqua nigricanti divisa, apicibusque fuscescentibus

Long. corp. unc. 1½. Expans. alar. unc. 3¾.

Affinis Cicadæ maculatæ. Caput nigrum orbitu interno oculorum sulphureo ; thorax niger maculis 8 sulphureis abdomen nigrum segmentorum marginibus pallidis. Alæ anticæ costâ sulphureâ, maculâque ovali maximâ (plus quam dimidium basale alarum occupante) sulphureâ fasciâ obliqua tenui nigrâ interné dentatâ divisâ; apice fusco nervis nigris Alæ posticæ ad basin sulphureæ, ad apicem fuscæ nervis nigris ; pedes nigri.

ORDER DIPTERA. Section Pupipara.

Fam. Hippoboscidæ.

Hippobosca Maculata.

Thorace fusco, flavo variegato, scutello nigricanti, maculis tribus flavis, mediâ majori, femoribus tibiisque posticis ad apicem fuscis.

Hippobosca equina ; " ex Indiâ orientali paullo major, thoraceque magis albo variegato, at vix distincta." Fab. Syst. Antl. p. 338.

Hippobosca maculata, Leach, " On the genera and species of Eproboscideous Insects." Wernerian Trans. vol. ii. p. 549.

Long. corp. lin. 4 Expans. alar. lin. $8\frac{3}{4}$.

Caput flavum, oculis fulvis, lineâ longitudinali inter oculos fuscâ. Proboscis nigra. Thorax fuscus, maculâ magnâ ad angulos anticos flavescenti in medio fuscâ ; fascia parva centrali lunulisque duabus in medio conjunctis posticis flavescentibus, scutello nigricante maculis tribus flavis media majori. Abdomen fuscum, punctatum, marginibus rufescentibus. Pedes fulvescentes tarsis omnibus femoribus tibiisque posticis ad apicem fuscis.

Fam. Nycteribidæ.

Nycteribia Roylii.

Obscure nigra pedibus fuscescentibus elongatis, vix compressis, coxis anticis brevibus, abdomine ovalo, conico, depresso, 5-articulato, apice subtruncato, stylis duobus incurvis subtus armato, capite compresso.

Long. corp. lin. $1\frac{1}{3}$.

Habitat in Indiâ Orentali.

Nyct. Roylii. Westw. in Trans. Zool. Soc. 1. p. 290-5.

ORDER COLEOPTERA.

Cetonia Roylii, Hope.

Long. lin. 12. lat. lin. 6.

Nigro-viridis thorace flavo marginato elytrisque quatuor maculis flavis notatis. Clypeus quadratus. Antennæ nigræ. Caput quadratum puncta-

tum. Thorax cupreis marginibus externis elevatis, lineaque flava utrinque externa, disco fortissime punctato. Scutellum magnum postice decitum. Elytra nigro-virescentia maculis quatuor flavis notata, binæ fere rotundatæ ad basin positæ, binæ aliæ reniformes ante apicem locatæ. Corpus infra nigro-æneum segmentis abdominis utrinque aurantiis capillis obsitis pedibusque concoloribus.

In Mus. Dom. Royle; in montibus Himalayæ captus ceria.

Geotrupes Orientalis.

Long. lin. 10. lat. lin. 6½.

Violaceus thorace sparsim punctulato, elytris striatopunctatis, pedibus supra nigris, infra violaceis nitidis. Antennæ piceæ capitulo fuscanti, thorax violaceus longitudinali serie punctorum in medio posita, variis aliis sparsim dispositis. Elytra striato punctata striis quasi vermibus erosis. Corpus infra violaceum nitidum, femoribus posticis uni-spinosis, tibiis pilosis, tarsis chelisque piceis.

This singular species approaches very closely to some of our British species, and is probably from a high elevation of the Himalayan mountains.

In Mus. Dom. Royle.

Onthophagus Phanœoides.

Long lin. 4½. lat. lin. 2¼.

Niger obscurus, clypeo cornu reflexo abrupte truncato, thorace phanæoformi, postice lateribus in spinam obtusam productis, femoribus luteis. Antennæ piceæ capitulo fuscanti: clypeus hexagonus cornu reverso abrupte truncato, thorax fere quadratus; punctatissimus, punctulis erosis tuberculo antice, fossulaque postice in medio marginis impressa, angulis posticis in spinas productis. Scutellum parvum nitidum. Elytra striata. Corpus suptus atrum nitidum punctatum. Pedes femoribus luteis, tibiis tarsisque nigropiceis.

This singular Insect will, at some future period, form the type of a new genus: in form it unites the South American Phanæus, and the widely-disseminated genus Onthophagus.

Lucanus Lunifer.

Long. lin. 37. lat. lin. 10.

Æneo-piceus, areolo tomento aspersus, mandibulis exsertis unidentatis, denticulisque minoribus instructis, apice bifurcatis. Clypeo deflexo lunifero, femoribus castaneis.

Hab. in Montibus Himalayæ; in Mus. Dom. Royle.

This Insect appears to unite in itself the characters of the Asiatic and

European species, the latter rather predominating over the former: it is one of the finest forms of the Himalayan Fauna.

Lamia Wallichii.

Long. lin. 16. lat. lin. 5.

Viridisericeus, Antennis penicillatis, elytris tribus fasciis nigris, binisque penicillis dosalibus ornatis. Antennæ corpore longiores et nigro-virides, primo articulo subpenicillato, tribus sequentibus atris, penicillis magnis pilorum barbatis, et reliquis pubescentibus, ultimo tamen pubescentia densiori tecto. Thorax viridis, spinosus. Elytra ornata tribus fasciis vix suturam attingentibus, una in medio elytrorum, secunda inter mediam et apicem, tertiaque binis penicillis dorsalibus interrupta. Corpus subtus nigro-virens, sanguinea pubescentia aspersum. Segmenta quatuor abdominis sanguineo colore fucata, ultimum omne autem viride et nitidum. Pedes viridi-pubescentes, femoribus maculâ rufâ notatis tarsisque infra flavis.

It is impossible to describe accurately the beauty of this Insect; the sericeous covering, in different lights, imitating the various tints of opal, while the dark fasciæ flash with the iridescence of Labrador felspar.

PORUS, Hope.

{ Stenidæ, ML.
{ Longipalpi, Lat.

Corpus oblongum fere parallelum subdepressum. Caput mediocre oculis magnis lateralibus. Antennæ crassæ articulis transversis. Mandibulæ acutæ dente interiori armatæ. Labrum transversum integrum ciliatum. Maxillæ elongatæ bilobatæ. Palpi maxillares longitudine mediocres articulo 3tio. longo clavato, ultimo minimo. Labium elongatum apice lanceolato, paraglossis lateralibus. Palpi labiales breves, articulo ultimo parvo conico. Thorax fere circularis. Abdomen elongatum marginatum. Pedes simplices. Tibiæ calcaribus binis armatæ Tarsis articulis simplicibus.

Porus ochraceus. Long. lin. 4. lat. lin. $\frac{3}{4}$.

Elytris punctatis antennis fuscis, mandibulisque ad apicem nigris.

Hab. in Montibus Himalayæ; in Mus. Dom. Royle.

This genus somewhat approaches our European Evæsthetus.

APHODIUS.

Aphodius irregularis, Hope.

Long. lin. 4. lat. lin. 2.

Flavus thorace nigro, elytris subaurantiis, fascia media maculis quatuor

nigris, pedibusque piceis. Antennæ piceo capitulo fusco. Caput angulis anticis oblique truncatis. Thorax niger nitidus punctatus, angulis anterioribus flavis. Elytra flava, seu subaurantia, fasciâ mediâ irregulari nigrâ, binis maculis humeralibus, binisque aliis fere ad apicem locatis concoloribus.

Hab. in Montibus Himalayæ; in Mus. Dom. Royle.

ANISOTELUS, Hope:

Telephoridæ.

Antennæ articulo Imo. crasso, reliquis multo crassiori, 9-10 obconices magnitudine paululum crescentibus ultimo majori ovato apice acuto. Mandibulæ valde acutæ. Maxillæ membranaceæ lobo unico intus tomentoso. Palpi articulo 1mo. minimo, 2do. et quarto æqualibus, ultimo subsecuriforme. Mentum transversum. Labrum membranaceum fere rotundatum. Palpi labiales breves, articulo ultimo majori securiformi. Caput transversum oculis prominulis. Thorax transversus lateribus rotundatis, angulis posticis acutis elevatis. Elytra sicut in Telephoris, in medio nonnihil dilatata. Tarsi 5-articulati, articulo penultimo bilobato.

Anisotelus Bimaculatus, Hope.

Long. lin. 4½., lat. lin. 2.

Lividus, elytris 2-maculatis. Antennæ articulo primo testaceo, reliquis fuscis. Thorax rufo-testaceus nitidus, elytris pallidioribus macula ovali nigra in singulo fere ad apicem posita. Corpus infra testaceum.

Hab. in Montibus Himalayæ; in Mus. Dom. Royle.

Elater Cyanopterus, Hope.

Long. lin. 4½., lat. lin. 1¼.

Cyaneus, antennis fuscis, marginibus thoracis pedibusque rubris. Caput nigrum antennis fuscis. Thorax in medio nigro-cyaneus, marginibus lateralibus rubris. Elytra striato-punctata subpubescentia. Pedes rubris.

Hab. in Montibus Himalayæ; in Mus. Dom. Royle.

Ripiphorus Apicalis.

Long. lin. 3., lat. lin. 1.

Rufus, thorace pedibusque nigris, elytris flavo-rufis quatuor maculis notatis. Caput atrum ramo antennarum piceo, foliisque nigris. Thorax concolor. Elytra flavo-rufa, basi nigrofasciata, maculis binis fere mediis, apicibusque corporeque infra nigris.

Hab. in Montibus Himalayæ; in Mus. Dom. Royle.—*Royle's Illustrations of the Botany, &c. of the Himalayan Mountains, Supplementary Part.*

(In connexion with the foregoing the following *Desiderata in the Entomology of India*, by the Rev. F. W. Hope, are republished from the *Calcutta Journal of Natural History*. No. 1.)

1.—Parasites of Birds, Lice, (*Nirmi*). Parasites of *Reptilia* (*Acari*) the name of the genus and species should be given on which they are found. Parasites of Quadrupeds, Ticks, &c.

2.—Endeavour to ascertain if the larger Beetles of India live more than one year; it is important also to ascertain the sexes of the *Atlas Beetles*, and the uses to which their horns are applied.

3.—Ascertain the names of the trees which yield *Resin Anime*; and if any other resins in India contain insects.

4.—Among *Coleoptera*, attend chiefly to the *Lamellicorn Beetles*, *Cetonia*, *Copris*, *Scarabæus*, and *Baprestidæ*.

5.—Ascertain by dissection of gigantic *Coleoptera* if the organs of hearing are in the basis of the antennæ as in *Crustacea*; collect the larvæ of all large *Beetles*, and try if they have the power of hearing.

6.—Send me an account of the habits of *Paussus*, and all the species you can obtain.

7.—Any species of insects infested with worms, should be noticed. The worms should have drawings made of them before put into spirits.

8.—All hermaphrodite insects to be noticed, as well as irregular copulation of different genera.

9.—All *Carrion Beetles* to be attended to. They are supposed to be *scarce* in India. The prejudice of caste and of religion will not allow many of the natives to touch a dead body of any animal.

10.—All species of silk-bearing insects used in commerce, with their local names and larva, eggs, &c. It is probable we may breed the Atlas Moths in England. Send Larvæ of any, placed in mould, when an opportunity occurs. Colonel Withill introduced alive into England *Bombyx Selene*. Any reports of the annual produce of silk useful.

11.—*Cochineal*, new species; intelligence wanted about its range. How many species in commerce in India. *Lac insect* also.

12.—*Bees*. All species of Bees to be collected. Any accounts of the produce of honey. The *native names* of Bees much wanted; any thing remarkable in the combs to be figured. All *parasite beetles* found in Bees' nests much wanted. Imports and exports of honey and wax. What are the Bees which produce the wax of the Chinese candles? there are several sorts.

13.—*Ants*. Collect all species of Ants—males, females, and neuters. Ascertain if they *lay up* stores of grain, seeds, &c.; be careful in marking the species. What Ants will drive out the White-Ants? Are the

different kinds employed by the natives, to drive out those which annoy them? Experiment on the formic acid. If the White-Ants' nests are ever used as ovens.

14.—*White-Ants.* Collect all species; attend to their parasites, particularly the *Beetles*, which attack them, and are found in their nests.

15.—What insects are eaten as food? Their Indian names. What *Locusts* are eaten, &c.?

16.—Mark those insects which cause any particular destruction of crops, and if the destruction is periodical.

17.—Mark all *luminous* insects. Ascertain if the *Lantern Fly* is *luminous*, it is disputed.

18.—What species of *Mygale* are in India? Their habits. What spiders yield silks, such as are found in commerce?

19.—What species of vesicatory insects are used in India? If any besides *Lytta* and *Mylabris.* If any insects are used medicinally. Their names.

20. Record any instance of death occasioned by insects, by Bees, Wasps, Hornets, or by Flyblowing, &c. Any ailments produced by insects swallowed in the larva state, &c.

21.—Is *Resine Anime* a preservative against the attacks of insects? Said to be used in corking bottles. Is cloth *coloured by Indigo* ever attacked by the White-Ants and other insects?

22.—Any native remedies against Cockroaches? Collect all species of, and particularly all sorts of *Earwigs.*

23.—Native remedies used after the stings of insects, and the attacks of Gnats, Scorpions, Centipedes, &c.

24.—Note all insects infesting houses. Does any true *Ptinus* occur in the East Indies?

25.—Species of *Æstrus* attacking quadrupeds; collect them. Do any attack man in the East?

26.—Collect all Aquatic Beetles. Do the *Gyrene* of India emit a peculiar smell? Do the *Carabe* emit an ammoniacal odour?

27.— Collect all Land-Crabs and inland *Crustacea.*

28.—Observe particularly the insects which destroy corn, rice, and all stores. What checks are in use?

29.—Note any extraordinary migration of Caterpillars, and indeed of all other insects.

30.—The *Mole Cricket* of the East Indies. What are its habits?

31.—Note the appearance of the clouds of Locusts.

32.—What are the preservatives used by the Indians in guarding their feathers and shawls? Colocynth supposed to be used.

33.—What genera and species of insects are used by the natives, in necklaces and ornaments, &c.?

34.—The habits of the large *Stag Beetles.* Do they destroy leaves?

35.—Note all odorous smelling insects.

36.—Are Beehives in use in India? Send specimens of domestic Bees, if they are domesticated.

37.—Is the *Sherifah*, or Custard-Apple seed, injurious to vermin? Flies are reported never to settle on the tree or its fruits. Ants will attack both.

38.—From what quarters chiefly do clouds of Locusts come?

IX.—*Memoir on the Mammalogy of the Himalayas.—By* Wm. Ogilby, Esq., m.a., *Fellow of the Royal Astronomical, Geological, Linnæan, and Statistical Societies; Secretary of the Zoological Society.*

In the early part of the year 1833, Professor Royle put into my hands an extensive Collection of Zoological Specimens, made during his excursions through the Western parts of the Himalayan Mountains, of which the rich Botanical results are now in course of publication, with a request that I would furnish him with a Catalogue *Raisonnée* of the different species of which it contained the spoils, to be added as an Appendix to his work. Whilst occupied in this easy and unostentatious task, various observations presented themselves, which induced me to propose to my friend a slight alteration of his original plan, so as to embrace a general outline of the Mammalogy of the Mountain Regions of Northern India, for the purpose of exhibiting, at one view, the intimate relations which I soon perceived to subsist between the animal productions of this elevated and extensive mountain chain and those of Northern Europe, Asia, and America. It soon became obvious, in fact, that the Zoology, like the Botany of the Hills, differed essentially from that of the sultry plains of India, which skirt their southern base; that, though occasionally mixed with tropical forms, it was, upon the whole, of a character closely resembling that of the more temperate and northern latitudes; and that the insulated position of these remarkable mountains, exhibiting, as they do, the rare and interesting phenomenon of a temperate and even a boreal climate on the very confines of the tropic, where the summer heat is necessarily greater than even under the equator itself, gave an importance to the inquiry, as connected with the geographical distribution of Animal Life, which promised the most important results. The nature of the

problem, indeed, and the very different conditions of Animal Life, as compared with that of Vegetables, forbade me to anticipate the discovery of laws of distribution in the Animal Kingdom, so definite and circumscribed as those which Baron Humboldt has established with regard to Plants ; the principle of animality, if I may be allowed the expression, possesses an innate power of adaptation which renders Animals in some measure independent of climate, particularly as compared with Vegetables, and which increases in proportion as we ascend in the scale of life ; but I felt that if any such laws of geographical distribution prevailed in Zoology, they might naturally be expected to be exhibited most clearly and unequivocally on a theatre like this, and therefore that the opportunity should not be neglected of investigating the circumstances of a problem which appeared to promise so much scientific interest.

From the observation just made, *viz.* that the power which all animals possess, in a greater or less degree, of adapting themselves to different varieties of climate, and of withstanding, uninjured, the effects of temperatures foreign to their natural habits, increases in proportion as we ascend from the lower to the higher tribes, it will be seen that the Mammalia—the class which I had undertaken to review—form one of the most unfavourable groups for the discussion of this important question. Indeed, were it not from their limited powers of locomotion, they would be the very worst of all, because their high position in the scale of life, and the superior intelligence and resources with which it endows them, necessarily protect them against changes and casualties, which would prove fatal to more simply organized beings ; but, deprived of the powers of flight, ordinary Mammals have not the means of traversing the wide deserts and oceans, which separate the habitable portions of the earth : the nature of their locomotive powers consequently confines them to particular regions ; and, in spite of the more favourable circumstances of their physical organization, their more varied resources and superior intelligence, they afford better materials for studying the problem of geographical distribution, than the kindred class of Birds, whose faculty of rapid flight enables them to set oceans and deserts equally at defiance, in passing to the most distant quarters of the globe, and, as it were, to choose their own temperature and climate in the boundless fields of air. Hence it is that the circumstances of the important problem of geographical distribution are less favourably presented in Ornithology than in Mammalogy ; but, with this exception, the observation above made holds good throughout all other classes of animals, and the simplest tribes will always be found to present the most certain results. Insulated families also occasionally occur, which possess peculiar advantages for the

prosecution of this inquiry ; as, for instance, in the case of fresh-water Fishes, than which I am acquainted with no other group of animals so well calculated to illustrate the laws of geographical distribution, or so likely to repay a careful study under this point of view ; and I am only surprised that no competent Ichthyologist has hitherto occupied himself with so promising an inquiry.

The only other principle which can well be regarded as influencing the geographical distribution of Animals, *viz.* the dispersion of Plants, upon which all Animals live, either mediately or immediately, is obviously subordinate to that of climate, with which it has been shown to be most intimately connected. On a limited scale the distribution of particular species may be seriously affected by the influence which civilization and cultivation produce upon the face of particular countries ; wild animals necessarily disappear with the woods and forests which afforded them food and shelter ; the Wolf, the Bear, and the Beaver, have thus disappeared from our own country ; the Capercalzie, exterminated about a century ago, is once more spreading rapidly over the pine forests of Scotland ; but these are partial cases, which do not bear upon the general problem of geographical distribution ; and it is obvious, that upon the great theatre of nature, climate and temperature are the only laws which regulate it, limited, indeed, by the physical structure of the animals, as has been already observed, and by their powers of transporting themselves to distant regions. Hence it is that terrestrial and fresh-water tribes are more favourable for this study than marine or pelagic ; though even among the latter, the comparative simplicity of their structure, and their consequent susceptibility of changes in temperature, render the habits of different genera and species more definite and confined than might otherwise be expected. Of the former, again, land and fresh-water Mollusks being among the most simply organized, are consequently most limited in point of range ; the species of Insects are almost equally confined, unless in the case of certain tribes, which are susceptible of being transported to distant countries in wood and other extraneous substances ; next follow Reptiles and fresh-water Fishes ; and, last of all, Birds and Mammals ; the former, as already observed, having an almost unlimited range of habitat, from the facilities which they derive from their powers of flight, of passing to the most distant quarters of the globe. The common Sparrow, the Snipe, and the Woodcock, for instance, are found in the Himalayas and in Japan, as well as in the North of Europe ; nature has endowed these birds with means of traversing the arid climes and extensive deserts which intervene between these localities, which she has denied to Quadrupeds ; and hence we must not expect to find the Badger and the Fox so widely distributed

as the Owl and the wild Goose. But if the same species of Mammals are confined to particular regions, the great question still remains, whether similar regions, wherever situated, or however separated from one another by intervening seas and deserts, produce kindred or analogous species of Mammals? and it is the general solution of this question in the affirmative, as far at least as the great continents of the globe are concerned, which renders the Mammalogy of the Himalayas so interesting in this point of view. We have here an insulated territory on the confines of the tropic, with a climate varying from the most intense heats of the Equator to the greatest rigours of the Pole; and we shall find, in discussing its animal inhabitants, that it presents, as it were, an epitome of the Mammalogy of the world; an intermixture, or rather a succession of species and genera similar to that which we meet in travelling from India to Kamtschatka, or from Brazil to Labrador.

Having thus fully explained the objects, it now only remains for me to acknowledge the sources from whence I have derived the materials of the following Memoir. The principal of these has been, of course, the Collection of Professor Royle himself, and the few notes, rendered particularly valuable, however, by containing the native names and localities, made by that gentleman during his tours. Besides which, the extensive Collections of the British Museum, of the Museums of the Zoological Society, the East-India Company, and various private collections of less note, which are occasionally made by Officers, and sent to their friends in this country, many of which I have had the good fortune to examine, have furnished me with valuable materials; whilst the different Notices and Memoirs on Indian Zoology, dispersed through the pages of the Asiatic Researches, the Journal of the Asiatic Society of Bengal, the Zoological Proceedings, and other similar publications, have been consulted with the greatest advantage. By carefully quoting my authorities, I have invariably taken care to distinguish what I have seen or know myself, from what is merely given on the faith of others. Yet with all these resources at my command, I have found my materials much too limited to give any thing beyond a mere outline of the Mammalogy of the Himalayas; but if this Memoir should prove to be the means of inducing future travellers, or residents, in those interesting regions, to fill up the sketch thus imperfectly traced, or assist them to distinguish what is already well known, from what still continue to be desiderata, in these inquiries, it will not have been without its use. The present time, indeed, is peculiarly favourable for such pursuits. India now contains many able and zealous naturalists; and what is not less fortunate, has a Nobleman for its Supreme Governor who both understands and can ap-

preciate the value of their pursuits. Drs. Cantor, M'Clelland, and Falconer, are skilful and practised observers; and Mr. Hodgson appears only to want access to European libraries and museums, an advantage unfortunately beyond the reach of the Indian Naturalist, to illustrate the Mammalogy of Nepal in the most ample and satisfactory manner.

Before leaving this part of the subject, I shall take the opportunity of offering a few remarks, which may be useful to that numerous class of intelligent and educated gentlemen, who are dispersed over every part of India; and who, from their taste for field sports and the facilities afforded by their situations, have the means of making the most valuable observations in various departments of Natural History; but which are too often neglected, not from any deficiency of zeal or inclination on the part of the observers, but from a want of practical experience in observing, from the difficulty of naming and describing the animals which fall under their notice, and from not knowing exactly what points to attend to. An accurate knowledge of specific differences, however, is by no means indispensable for this purpose; generally speaking, it is sufficient to indicate the affinity of the animal to the most approximate European species, and to ascertain its native name, in order to enable the more practised Zoologist to recognize it with sufficient accuracy, especially if the forms of the feet, teeth, ears, &c. be carefully noted: but the main points to be attended to, and those, unfortunately, which the generality of observers most neglect, are the habits and economy of the animals which fall under their notice; their manners, whether aquatic, arborial or terrestrial; whether they inhabit burrows, or reside among thick jungle, or on the naked open plain; whether they live in society or solitary; the number of young which they produce at a birth; their period of gestation; the duration of life; their instincts, and the stratagems which they employ to capture their prey or to escape from their enemies; the nature of their food; whether they hibernate or migrate from place to place, according to the season; whether they are turned to any account by the natives, or are capable of yielding any products applicable to the purposes of commerce or domestic economy. These, and other similar inquiries, of the utmost importance to the philosophical Zoologist, are within the ordinary range of daily observation to most gentlemen in India, with respect to many rare and interesting animals; whilst they are, generally speaking, attended with so little trouble, and at the same time productive of so much mental recreation and instruction, that it is only surprising how much they have been heretofore neglected. One principal cause of the apathy which our countrymen in India have shown, if not in making, at least in recording,

their observations on various branches of Natural History, may, indeed, have arisen from the want of some common central institution, where they could be properly arranged and published ; but the establishment of the Zoological Society of London, and the unrivalled resources which it possesses, offer facilities for this purpose, which it is hoped will hereafter be made extensively available by Englishmen in all parts of the world. It is scarcely necessary to add, that any interesting details relative to the habits and manners of foreign animals, observed in their native climates, will be gladly received from any quarter, and published in the Proceedings of the Society ; especially if accompanied by the skins of the animals (the skulls, legs, and tail, being carefully preserved), for the purpose of identification. The Journal of the Asiatic Society contains numerous articles on Natural History, but its contributions in this department are fewer than could be wished : whilst the Bengal Sporting Magazine, hitherto in a great measure confined to mere journals of shooting excursions, might likewise be made a ready and appropriate medium for the publication of such observations ; and the contributions of its various correspondents prove them abundantly qualified for this higher and more important object.

These introductory observations being premised, I shall now proceed to enumerate such Mammals as I know to inhabit the great Himalayan Chain ; and without following any formal arrangement, shall throw them into such natural groups or families, as appear best suited to illustrate their geographical distribution with respect to climate and temperature, the principal object of the present Memoir.

QUADRUMANA.

Throughout Bengal and the nothern provinces of British India, there appear to be only two species of *Simiæ*, the Hoonuman (*Semnopithecus Entellus*), and the Bhunder (*Papio Rhesus*) ; both of which ascend the hills to a very considerable elevation during the summer heats, and return again to the plains at the commencement of the cold season. This migration is a very interesting fact in the history of these *Simiæ* ; it is the only instance of a similar phenomenon, which has been recorded of this family of Mammals, and may become of great value in its application to geological reasoning on the climate and temperature of Europe during the tertiary epochs, in the deposits of which periods the bones of Apes and Monkeys have lately been found, associated with the remains of Pachydermata, and other inhabitants of more tropical latitudes. The Hoonuman, called *Lungoor* by the Hill tribes, is not unfrequently found at

an elevation of from 9,000 to 11,000 feet, as among the Pine forests in the neighbourhood of Choor, and sometimes even at the verge of the snow-line. Nay, it even appears to have succeeded in crossing the mountains; Turner* mentions having seen a large troop of these monkeys in Bootan, where they are held in the same veneration as in Hindustan; and that it has found its way, and is capable of subsisting in a state of nature, at a considerable elevation, and a comparatively low temperature, is sufficiently evinced by these facts, as well as by the testimony of Fraser,† Traill‡ and other intelligent travellers. Dr. Royle found it common enough in the neighbourhood of Hurdwar in April, and on Tuen and Manma at 9,000 feet of elevation in the latter end of May and in June.

The Bhunder, Bender, or Bandar, the Common Monkey of Bengal and Upper India (*Papio Rhesus*), though said by Mr. Hodgson to exist in the central regions of Nepal, only in the vicinity of the temples, and in a semi-domestic state, whence he conjectures it to have been introduced from religious motives, is also reported to abound in Kumaon; and it is highly probable, that the nearly allied species (*Papio Assamensis*) lately discovered by Mr. M'Clelland in Assam, ascends the more eastern hills, as its congener does the central and western ranges. Of this, however, we have no positive knowledge, though the close affinity of the animals gives a strong degree of probability to the fact; but the various species of Monkeys which Mr. Fraser thinks may be found along the upper courses of the Jumna and Ganges, rest on more questionable authority; and it is not unlikely that this intelligent traveller, as indeed he has himself conjectured, was deceived by distance, variety of size, and other circumstances, which give a very different appearance to individuals of the same species. Mr. Hodgson§ gives the Bonnet Monkey (*Cercopithecus radiatus*) as a native of Nepal; but this species is confined, as far as at present known, to the Peninsula and western coast of India, and seems to have been confounded by Mr. H. with the *Papio Rhesus*, or Bhunder of Hindustan. The same gentleman, in a letter to the Zoological Society, written some years ago, mentions that his shooters were once alarmed in the Kachar, or Alpine regions of Nepal, by the appearance of a wild man, which walked erect, was covered with long dark hair, and had no tail. The improbability of finding a real Ape in such a situation led him to question the truth of the report; but it is well known that the woods of the lower ranges to the east of Nepal contain at least one species of Gibbon, *Hylobates Scyritus*, called *Hooloo* or *Hooloc* by the Assamese; and

* Journey to Thibet, p. 147. † Journey in the Himalayas. p 351.
‡ Asiat. Res. XVI. 153.
§ Proc. Zool. Soc. II. 96.

it is not improbable that individuals may occasionally wander to the higher and more remote forests of the Central Hills.

CHEIROPTERA.

When it is recollected that of the sixteen species of Bats, now known to inhabit the British islands, no fewer than ten have been discovered within the last few years, it will not appear surprising that we should be so imperfectly acquainted with this department of Himalayan Mammalogy. Mr. Hodgson, indeed, is the only author who has furnished us with any details on the subject: his "Synopsis of the Vespertilionidæ of Nepal," published in the Journal of the Asiatic Society of Bengal, vol. iv. p. 699, contains an enumeration of seven species of *Cheiroptera:* but, as he himself very candidly observes, his specific identifications must be received with considerable caution, from his want of access to extensive libraries and museums, for the purpose of comparison. Of the two species of *Pteropus*, for instance, which he has there briefly described under the names of *P. leucocephalus* and *P. pyrivorus*, the former does not appear to differ from the *P. medius* or *Edwardsii* of the Plains; and the probability of its identity with that species is increased by the fact, which Mr. Hodgson mentions, of its only visiting the temperate regions of Nepal during the autumn, returning of course to the more sultry plains of India on the approach of the cold season. The *Pteropus rubicollis* of Mr. M'Clelland's "list of objects of Natural History collected in Assam," is likewise identical with the *P. Edwardsii.* The only other species of tailless *Pteropus* known to inhabit the continent of India, *Pteropus Dussumieri*, is very different in its characters from *Pteropus medius;* and as Dr. Royle brought undoubted specimens of this latter species from the lower hills a little farther west, it is but reasonable to suppose that it is equally common in Nepal, and consequently identical with Mr. Hodgson's animal. The *Pteropus pyrivorus*, to judge from the short description given by Mr. Hodgson, appears to be less questionably a new species: it belongs to the second section of the genus, having a short tail, partly free and partly enveloped in the membrane, and derives its specific name from the depredations which it commits among the ripe pears in the central regions of Nepal. The migratory habits ascribed to these *Pteropi* are common to the *Pteropus poliocephalus* of New South Wales, and many other species of the same genus; for these large frugivorous *Cheiroptera* are essentially tropical in their habitats, and only visit more temperate climates during the summer and autumn heats, when the ripe fruits tempt them to wander from their native regions. They are conse-

quently but occasional visitors to the higher elevations and latitudes of the globe; and the *Pteropus dasymallus* and *Pteropus pselaphon*, which have been hitherto observed only in Japan, comparatively a high latitude for these animals, do not probably form an exception to the general law.

Of the *Insectivorous Cheiroptera*, a family far more abundantly and extensively dispersed over the surface of the globe, Mr. Hodgson indicates only five species as natives of Nepal. Three of these are described as *Vespertiliones*, by the specific names of *formosa*, *fuliginosa*, and *labiata*, and two as *Rhinolophi*, by the names of *armiger* and *tragatus* respectively; but without a more careful examination and comparison with other species than Mr. Hodgson had it in his power to make, it is impossible to say how far these Bats may be distinct from, or identical with, species already described. One thing at least is certain, that the temperate and more elevated regions of the Himalayas must contain many species of *Insectivorous Cheiroptera*, still unknown or undistinguished, besides those enumerated by Mr. Hodgson; it has been already observed, that this section of the family is very widely and generally distributed in temperate climates; and the rich harvest which has attended the researches of British naturalists, within the last few years, in their own country, ought to stimulate our Indian brethren to a pursuit which cannot fail to be rewarded by still more extensive discoveries. It would be extremely interesting, for example, to procure a complete series of Himalayan Bats, with the seasons, temperatures, and elevations at which they were captured carefully noted down, so as to compare them with analogous species of higher latitudes, and thus ascertain what law of succession the different forms may follow, or within what limits they may be confined in respect to temperature, in their geographical distribution over the surface of the earth. Speaking of these *Insectivorous Bats*, Mr. Hodgson observes, that " they are neither migratory nor subject to hibernation;" two properties which in more northern climates would be considered incompatible with one another, and which even in the central regions of the Himalayas require a very careful revision before they can be admitted as established facts. I am not aware that these animals ever migrate in any climate; hibernation is the resource which nature has provided to preserve them during the season when their natural food disappears; and it is the general opinion, that even within the tropics, the Insect-feeding Bats go to sleep at certain seasons, as they do throughout the winter in more northern latitudes: should the fact be otherwise, it would prove a highly interesting addition to our knowledge of their habits; but it is possible that Mr. Hodgson may have been led into error, by the casual appearance of a few individuals during an occasional fine

evening, as sometimes occurs in Britain even in the depth of winter. The subject is well worth the attention of Indian Zoologists.

INSECTIVORA.

Ascending gradually from the *frugivorous Cheiroptera* of the Plains of India, which visit the hills only during the summer heats, through the insectivorous genera of the same family, which remain throughout the whole year, we next come to the *Insectivora*, properly so called ; a family which belongs almost exclusively to the temperate regions of the earth ; and of which it is therefore extremely interesting to find the common forms of Europe and Northern Asia occurring in the analogous climates of the Himalayas. No fewer than three distinct species of Hedgehogs, for instance, have been described from the Western Hills :

Erinaceus spatangus, a small dark-coloured species, not more than twice the size of a large mouse ;

Erinaceus Grayii, of a grizzled black and yellow, from the spines being annulated with these two colours, rather smaller than the common European species ; and

Erinaceus collaris, by some supposed to be identical with *E. Grayii*, but easily distinguished by a white collar half surrounding the neck. All these species, however, require a careful revision ; they are founded on single specimens, those of the two former deposited in the Zoological Society's Collection, that of the last in the British Museum, and of which a figure is published in the Indian Zoology of Messrs. Hardwicke and Gray. It is possible that more extensive and accurate observation may prove the whole three to be identical: at all events, it is certain that one, either of these, or a different species (*Erinaceus indicus* of Royle's Illustrations, &c. p. 6), inhabits the neighbourhood of Delhi, where it would be interesting to observe the phenomena attending its hibernation, such as the temperature of its body, the nature of its respiration, &c. during the period of repose. Mr. Hodgson, in the letter to the Zoological Society, already referred to, denies that there are any Hedgehogs in Nepal, but mentions a small dull slaty-blue variety of the common Indian Shrew or Musk Rat (*Sorex indicus*), as common in the lower and central regions, to which he speaks of it as being confined. Other species no doubt exist in the more temperate parts of the mountains, though their small size and shy habits screen them from observation. The same gentleman mentions the Mole (*Talpa*), as abounding in the Kâchar, or northern region of Nepal, and Traill* says it is common

* Asiatic Researches, vol. xvi. 153.

in Kemaon; but no one appears to have described, or even examined it, and we are ignorant of every thing relating to it, except the name. It will probably prove to be a distinct species from its European congener, if it exist at all; but the question is involved in great doubt, and is well worthy of a careful examination.

CARNIVORA PLANTIGRADA.

Of this family, the majority of which likewise belong to the temperate regions of the earth, various forms and species occur among the Himalayas. First, of the genus *Ursus*, we have the *Bhaloo*, or Common Bear of India (*Ursus labiatus*), and, according to Mr. Hodgson,* the Malay Bear (*Ursus Malayanus*), inhabiting the Turai, or sultry regions, at the base of the mountains, to which localities he appears to intimate that they are confined. But the habitat here assigned to the Malay Bear is extremely doubtful. It rests solely on the authority of Mr. Hodgson, who, from the want of proper means of comparison, is often mistaken in the identification of species; moreover, we have never received this animal from any part of Continental India, but only from the great islands of the Indian Archipelago; and it is therefore not improbable that it may have been in this instance confounded with the *Ursus Thibetanus*, which, from the general similarity of the two species, may have readily happened. Mr. Hodgson, indeed, expressly mentions this latter species as an inhabitant of the Central and Northern regions of Nepal; and Dr. Royle informs me, that it is confined among the more western hills, to the Doon and warm valleys, where it is called Reech by the natives. Lieut. T. Smith, of the 15th regiment N. I., however, an officer well acquainted with the Mammals of the Himalayas, and a keen sportsman, assures me that the Common Sloth Bear (*Ursus labiatus*) does not ascend above the lower spurs of the great Mountain Chain of Northern India; that it is there replaced by the *Reech* or *Reek*, which occupies the whole of the more elevated hills, as far up as the snow line, where it is succeeded in its turn by the *Barji* or Yellow Bear (*Ursus isabellinus*), a species hitherto very imperfectly described, though mentioned by every tourist as extremely abundant in the higher regions of the Himalayas. Capt. Skinner† met with it in the neighbourhood of Bhairo Ghati; Traill‡ found it in Kemaon, though he says it is peculiar to Bhot; and it is probably the Brown Bear mentioned by Mr. Fraser:§ so that upon the whole it appears, that whilst the

* Proc. Zool. Soc., ii. 96.

† Excursions, &c. ii. 72.

‡ Asiat. Res., xvii. 16.

§ Journey, &c. p. 351.

Common Sloth Bear (*Ursus labiatus*) is on all hands admitted to be confined to the sultry plains of India, the Reech (*Ursus thibetanus*) succeeds it, as the legitimate representative of the European Bear (*Ursus Arctos*), and of its American analogue (*Ursus americanus*), in the middle or temperate regions of the hills, to be itself replaced among the frozen peaks of the higher mountains, by the *Barji*, or Yellow Bear of the Himalayas (*Ursus isabellinus*), a species in all respects analogous, in its colour and habitat, as well as in its decidedly carnivorous appetite, to its congener, the Polar or Sea Bear of the North (*Ursus maritimus*).

Various animals, either belonging or closely allied to the Gluttons and Badgers (*Gulo* and *Meles*), pre-eminently northern forms, likewise inhabit the elevated ranges of the Himalayas. Among the lower terraces we have the Ratel (*Rattelus mellivorous*), called *Peejoo* by the Hindoos, which is common over all the plains of Northern India, and differs from the same animal, as found at the Cape of Good Hope, only in being of a lighter colour on the back. This wide distribution of the *Carnivora*, and the common occurrence of the same species in India, and the most remote parts of Africa, will be more particularly mentioned in the following article: Mr. Hodgson,* under the erroneous impression that the Peejoo, which the Nepalese call *Bharsiah*, was an unknown animal, and evidently misled by some imperfect or faulty account of its dentition, has recently described it as a new genus under the name of *Ursitaxus inauritus*; but the species has long been well known in Europe. M. F. Cuvier figured, and accurately described its teeth in the "Dents des Mammiferes," so long ago as the year 1825; and the late Mr. Bennett described and figured the animal itself in 1830, from an Indian specimen then living in the menagerie of the Zoological Society.† The *Balloo-soor*, (perhaps more properly *Bhalloo-soor?*), *Meles collaris*,‡ which M. F. Cuvier likewise elevated to the rank of a generic form, under the name of *Arctonyx*, upon the faith of a distorted native drawing sent to him by M. Duvaucel, is a real *Badger*, and was described and figured by the celebrated Bewick, at least thirty years before M. Duvaucel's visit to India. It inhabits the northern plains of Hindostan, and probably ascends the hills, but of this fact I have no certain information. Of the Gluttons, properly so called, the *Gulo nepalensis* of Mr. Hodgson, which does not differ specifically from the *Gulo orientalis* of Dr. Horsfield, the only distinction being in a lighter shade of ground colour, inhabits the

* Res. Asiat. Soc. xix., and Journal of Asiat. Soc., v. 671.

† Gard. and Menag., &c. i. 13.

‡ Penny Cyclopædia, iii. 264.

lower terraces of the hills; whilst the *Wah*, or *Chitwah* (*Ailurus fulgens*) and the *Benturong* (*Arctitis Albifrons*)* are said to be confined to the Kachar, and regions bordering on the snow-line. As regards the *Wah*, there is no doubt about the truth of the habitat here assigned to it; but the *Benturong* is a native of the Indian Archipelago, and of the Peninsula of Malacca; and I strongly suspect, that it has been confounded with some other animal, perhaps with *Paradoxurus bondar*, or some closely allied species. The habitat of *Bootan*, assigned to it in the *Regne Animal*, is altogether erroneous. Messrs. Gray and Isidore Geoffroy have proposed to consider the *Gulo nepalensis* as the type of a new genus, the former under the name of *Helictis moschata*, the latter under that of *Melogale personata.*

CARNIVORA DIGITIGRADA.

It was mentioned incidentally in the preceding article, that many species of *Carnivora* were common to India, and the Continent of Africa; and it is not a little singular, that this migration appears to have proceeded exclusively from west to east, and never in the opposite direction; or, in other words, that whilst the *Carnivora* of Africa have found their way freely into the neighbouring Continent, those of India have never passed the Arabian desert. I do not pretend to account for this. Perhaps it may depend upon the physical character of the two Continents, and the influence which this circumstance exerts in modifying the nature and habits of their respective inhabitants. The Lion of the burning Sahara, for instance, like the wild Taurick or Bedoween of the same regions, would find the parched deserts of Syria and Persia no barrier to his progress towards the East; whilst, on the other hand, the Tiger of the moist jungles of Bengal could no more pass the arid plains of Arabia than the puny and luxurious Hindoo, accustomed to the same humid soil and atmosphere. But whatever may be its cause, the fact itself is as undoubted as it is interesting. The common distribution of the *Ratel* over both Continents has been already mentioned. This animal is spread over the whole of Africa; it is common in every part of the Cape colony, and Denham and Clapperton brought it from Bornou; and though its geographical limits have not been accurately ascertained in Asia, we know that it abounds on the plains of Northern India, which do not differ much in their physical structure from the Karroos of South Africa. So

* Mr. Hodgson, in Zool. Proc., ii. 96.

likewise the Lion (*Felis Leo*), the Leopard or Panther, for they are both the same species (*Felis Pardus* and *Leopardus*), the Cheetah (*Felis jubata*), the Persian and Red-eared Lynxes (*Felis Caracal* and *Felis Chaus*), the striped Hyæna (*Hyæna virgata*), and the Jackall (*Canis aureus*), all pre-eminently African species, are found in most parts of India, without offering any striking variety either in form or colour; whilst the Tigers, Wolves, Paradoxures, &c. of the latter country have never passed far to the west of the Indus, and some of these are even without generic representation on the Continent of Africa: nor is it less singular that, as far at least as at present known, this migration should have been confined to the Carnivora. There is not a single authenticated instance of any of the numerous Antelopes in which Africa abounds above all other parts of the world, and which nature has peculiarly adapted to inhabit the most parched and arid deserts, having crossed the Isthmus of Suez, any more than of the various species of Deer so common throughout the whole extent of Asia having migrated in an opposite direction. If the various indications which Mr. Hodgson has given of the occurrence of species known to inhabit the great islands of the Indian Archipelago, and the southern extremity of the Malay Peninsula, such as the Benturong (*Arctitis albifrons*), the Malay Bear (*Ursus malayanus*), and the Javanese Ichneumon (*Herpestes javanica*), in the forests of the Turaï, which skirt the southern foot of the Himalayas, should turn out to be correct, (and it is certain that *Felis minuta* and *Gulo orientalis* are common to both these localities), it would appear that India Proper, besides its own appropriate Mammals, is a kind of neutral ground upon which the species of the most distant countries to the east and west of it meet and mingle together. One fact, abundantly singular, but which I have never seen accounted for, is the alleged total absence of every species of the genus *Canis*, so numerous and so common throughout all parts of India, in Burma, Siam, and those other countries east of the Brahmapootra, which compose the great Malay Peninsula. This is a phenomenon well worth the attention of Indian Naturalists.

As far as regards the occurrence of the *Digitigrade Carnivora* among the Himalayan Mountains, it is certain that the Lion, called *Baug* by the Indians, ascends the western hills to a very considerable elevation. Mr. Fraser often heard of it during his journey to the sources of the Ganges

and Jumna,* and Bernier, whilst travelling to Cashmere, in the train of Aurungzebe, had frequent opportunities of witnessing the chace of this animal: the amusement was reserved for the Emperor alone, and the success of a day's sport was recorded by the Imperial Historiographer in the annals of the empire. The same indifference to climate characterises the Lion in Africa; in the time of Herodotus and Aristotle, he was common among the coldest mountains of Macedon; at the present day he is as often found among the snowy peaks of the Atlas, or on the chilly slopes of the Snueuberg, as in the desert of Barca, or on the banks of the Gareip. Travellers should look for him to the east of the Brahmapootra, as though not known to inhabit any part of Eastern India, the Burmese are said to have figures which can be intended for no other animal, and which can only have been drawn from the living model. The Tiger and Leopard are well known to inhabit every part of the Himalayas, even to the line of perpetual congelation: they exist equally in Japan, in the Caucasus, and in the Altai Mountains in Southern Siberia.† The Tiger of Bockhara is less than the Bengal variety, and chiefly confined to the Valley of the Oxus;‡ whilst in Japan he is covered with a thick coat of long soft fur, to protect him from the rigours of that northern climate. The *Cheetah* is said by Mr. Hodgson§ to occur chiefly among the lower valleys of the Himalayas, but Pallas found it as far north as the Caspian Sea and the deserts of the Khirgis Tartars, so that it may possibly ascend the Hills to a greater height than has yet been suspected. Lieut. Smith mentions a small dark coloured variety of the Leopard, called *Luckur-backer*, extremely fierce, and common in every part of the Hills.

Among the smaller species of the genus *Felis*, the Moormi Cat (*Felis moormansis*) first described by Mr. Hodgson, and hitherto observed only by that gentleman, as likewise the *Felis Bengalensis* or *nepalensis*, are stated to inhabit the middle terraces of Nepal§. The *Felis Viverrinus*, first described by Mr. Bennet‖ in 1833, and three years afterwards by Mr. Hodgson, under the nearly identical name of *Felis Viverriceps*,¶ inhabits the lower terraces and valleys of the Turaï. *Felis Chaus*, (called

* I beg to observe here, that I frequently made inquiries on this subject, and could never learn anything positive on the subject; nor had any of the numerous sportsmen to whom I spoke on the subject, ever seen a Lion or its skin, obtained from within the Himalayas. At present, the Lion is I believe only found to the west of the Jumna, especially on the edge of the desert, near Hansi. J. F. R.

† Pallas Zoog. Ros., i. 16.

‡ Burnes' Travels, ii. 178.

§ Zool Proc., ii. 97.

‖ Zool. Proc., i. 68,

¶ Journal Asiat. Soc., v. 232.

Biraloo in Nepal), of which I have compared numerous African and Indian specimens, extends over every part of the Hills: it is the *Felis erythrotus* of Mr. Hodgson;* and there is a specimen of a Himalayan Cat in the Museum of the Zoological Society, so closely resembling the common Wild Cat of Europe, that it differs only in the absence of the dark transverse and longitudinal stripes which mark that species, and which may not improbably be a mere effect of locality.

Mr. Hodgson† has described three species of Paradoxuri as inhabitants of the Southern, Central, and Northern regions of Nepal respectively, two of which at least I have seen from the more Western Hills; *P. Bondar* (P. hirsutus, Hodg.) is confined to the Turaï; *P. nepalensis*, Hodg. frequents the middle ranges of the mountains, and *P. larvatus*, (P. lanigerus? Hodg.) is only found in the higher regions. Two species of Mungoos *(Herpestes)* likewise inhabit the lower terraces; *H. griseus*, called Nyool in Nepal, does not extend beyond the Turaï, but *H. Edwardsii* (H. auropunctata, Hodg.)‡ ascends the central hills; whilst *Viverra Rasse* and *indica*, and *Viverra Zibetta*, are said to frequent the same localities respectively.

The true Mustelæ, a genus proper to more northern latitudes, abound in the Himalayas, where there appear to be many different species, some of which, according to Mr. Hodgson, differ but little from those of Northern Europe and Asia. It is to be remarked, however, that they have never been properly compared; but it is interesting to find this additional instance of the relation between generic forms and climate. In the central region, besides *Mustela flavigula*, Mr. Hodgson mentions two closely allied species, one larger and of a fuller habit of body, (query, Paradoxurus larvatus?); the other, which he has described under the name of *Mustela Kathiah*, is much smaller, and often domesticated by the Nepalese for the purpose of destroying vermin, and sometimes even large animals.§ This appears to be the *Kukar* of Kemaon, where it likewise frequents the villages, burrows in the walls of houses, and is similarly protected by the inhabitants.‖ The *Mustela lanigera* of Mr. Hodgson resembles the common Weasel of Europe, but differs in its spirally twisted hair; and the same gentleman mentioned another species so nearly approaching our common Pole-cat, that he is unable to perceive any specific difference; however it will probably turn out to be distinct. Both these latter species abound in the northern and

* Journ. Asiat. Soc., v. 232.
† Asiat. Res., xix. I. 72.
‡ Zool. Proc., i. 68.
§ Journ. As. Soc., iv. 703.
‖ Asiat. Res., xvii. 16.

central regions. No fewer than seven species of Otters are said by Mr. Hodgson to inhabit the Himalayas; but they require to be carefully studied and compared, before we can venture to pronounce definitely upon their specific distinction. It is certain, indeed, that several species do actually exist in these Hills; Mr. Hodgson has himself given brief characters of four which he regards as new,* besides the two common species of the plains, (*Lutrae Nair* and *Leptonyx*), and seems to intimate that the seventh may be no more than a variety of the common European Otter.† The following is the substance of Mr. Hodgson's observations in the letter already referred to, and I give them at length in the hope that they may induce other observers to co-operate with that gentleman in filling up the sketch of which he has given an outline. "Of Lutræ we have seven species, five differing from the two usually found in the plains, as well as from all described species, except the common Otter (*L. vulgaris*), of which the largest Nepal species seems to be only a variety. It is five feet long, including the tail, and is the largest, though not the longest of our species. It is peculiar to the lower region, where also three other species inhabit: two more belong to the central, and one to the Kachar. One species is yellowish brown all over; the others brown, more or less dark, some having the chin and throat much paler than the rest of the body, and approaching nearly to white or yellow. They differ in length from five feet to one and a half feet; some being quite vermiform, and others as bulky as the Badger. Detailed descriptions, skulls, and skins of these animals, are much wanted."

Of the genus *Canis*, different species are found everywhere. The common Pariah Dog is universally dispersed through the mountains, but the Thibet Mastiff is confined to the Kachar, into which it is imported from its native country. There are many distinct varieties of this noble animal. That called *Sassa*, a large black kind, with dew claws on the hind feet, is esteemed the finest: another called *Mustang* is of a bright red colour. The common Wild Dog, called simply *Junglee Coota* in the Plains and *Buansu* in Nepal (*Canis Duckunensis* of Sykes and *C. primævas* of Hodgson) is only found in the lower regions, but is replaced farther up by two other wild species, likewise called *Junglee Coota* by English sportsmen. Lieut. Smith informs me that one of these is larger and the other smaller than the *Junglee Coota* of the Plains, from which they both differ in having shorter tails and a lighter or more ashy colour: both species ascend the Hills even to the snow line; they hunt in packs, and

* Journ. As. Soc., viii. 319. † Letter to Zool. Soc.

inhabit ravines and rocky dells; but, being excessively shy, are not very often seen. The *Junglee Coota* of the Plains, in other respects, does not appear to me to differ from the *Canis Sumatrensis* of General Hardwicke. The *Kokree*, or small Indian fox (*Canis Corsac, Indicus, Bengalensis, Kokree, &c.*); and the *Berria*, or Wolf of India (*Canis pallipes*, Sykes), never ascend the Hills. The Jackall (*Canis aureus*), is however occasionally said to be found in the central regions; but the higher mountains are inhabited by a very beautiful species of Fox, which Dr. Royle first noticed as the Hill Fox,* and of which he brought home the first skin ever seen in England, and which was described at the time in the present memoir, and afterwards in the Proceedings of the Zoological Society, Part iv. p. 103, by the name of *Canis Himalaicus*. Mr. Pearson, then Curator of the Museum of the Asiatic Society at Calcutta, likewise described it about the same time as the latter;† and as he had a few months priority in point of publication, his name of *Canis montana* must have the preference.

The Hyæna of India (*H. Virgata*), a native of the Plains, sometimes ascends even to Simla.

RODENTIA.

The remark which was formerly made to account for our limited knowledge of the *Cheiroptera* and *Insectivora* of these mountains, may be applied with equal force to the present family; *viz.* that the comparatively diminutive size and timid habits of the animals which compose it screen them from general observation. Still we have much more detailed accounts of the Himalayan *Rodentia* than of either of the two former families, though even these are far from being so complete as could be wished.

The striped Squirrel of the Plains (*S. palmarum*) is, according to Mr. Hodgson,‡ abundant in the lower hills of Nepal; and I have seen a second species (*Sciurus Lokriah*, Hodg.) of the same size, but of a uniform earthy brown colour, tipped with golden yellow, which is said to be an inhabitant of the central regions. Mr. Hodgson mentions a third (*S. Lokroides*) similar to the latter, and perhaps not specifically distinct.§ Two beautiful species of flying Squirrel‖ (*Pteromys magnificus* and *P. alboniger*, Hodg.) are found both in the northern and central regions,

* Journ. As. Soc., i, p. 99, 1832.
† Journ. As. Soc., v. 113.
‡ Proc. Zool. Soc., ii. 98.
§ Asiat. Res., xvi. 153.
‖ Asiat. Res., xvii. 16.

but do not extend to the very elevated parts of the mountains.* Here, however, are found a small brown kind of Marmot, called *Bhia*† by the natives, hitherto undescribed; and an equally undescribed species of Rat,‡ with a tail not more than half an inch in length, most probably a Lemming (*Georychus*, Illiger), if it be not rather a *Lagomys*, of which rare and essentially arctic genus Doctor Royle has brought a beautiful specimen from the Choor Mountain. Captain Herbert, in his tour up the Valley of the Sutlej,† met with this tailless rat at an elevation of 12,000 feet, and observes that the ground was every where cut up into groves by it in search of food. He conjectures the animal to be a species of Spalax, but Dr. Royle is rather disposed to think that it was no other than the Lagomys, as he observed the ground similarly cut up in the vicinity of the spot where he obtained his specimen. The circumstance of the tail, however, which, short as it is, is expressly mentioned by both Capt. Herbert and Mr. Traill, appears to me to preclude Dr. Royle's supposition, since the Lagomys of the Himalayas, like the rest of its congeners, is absolutely without any rudiment of this organ. It is not improbable, indeed, that species of all the three genera here mentioned may be found among the more elevated ridges of the Himalayas, of which the climate is perfectly adapted to their habits: and it is to be hoped that future observers will direct their attention to the elucidation of this, as well as the numerous other unsettled points of Himalayan Mammalogy, to which I have already been so frequently obliged to refer.

Dr. Falconer, in the report of his recent journey to Cashmere and Little Thibet, mentions a Rodent under the name of the Thibet Marmot, which he says was first found in a bleak and rocky tract of country, immediately after passing to the northern slope of the great Himalayan range; but we have no farther knowledge of its characters: however, this is precisely the locality in which Mammals of this description might naturally be expected to abound. Rats and Mice, differing little, if at all, from our common European species, are abundant in all the houses. Mr. Hodgson,† indeed, expressly states that both our black and brown, or Norway rats, (*Mus Rattus* and *M. decumanus*), are the common species of Nepal, and Mr. Traill mentions them incidentally as inhabitants of the province of Kemaon. This is another interesting and important point of similarity between the Zoology of the Himalayas and that of the more northern parts of Europe and Asia; nor can we attribute the presence

* Journ. As. Soc., v. 232.

† Asiat. Res., xv. 5.

‡ Proc. Zool. Soc., ii. 98.

of these animals, in this part of the globe, to the introduction of European conquerors, as is well ascertained to have been the case in America* and Australia, since they are confined to the mountains, and altogether unknown in the Plains of India, except perhaps in some of the largest seaports. They must consequently have travelled south to reach their present habitat; and, no doubt, exist in Thibet, Tartary, and other intermediate countries, where the climate is suitable, as far as Northern Asia, from which at least one of the species (*M. decumanus*) is said to have been originally introduced into Europe. Besides these, Mr. Hodgson describes two other species (*Mus niviventur* and *M. nemorivagus*) as peculiar to the Himalayas; and I have received a Rat from Dr. Royle, which in the dried state of the specimen I cannot distinguish from the common European Campagnol (*Arvicola vulgaris*), a fact the more interesting from this genus being confined to the temperate and colder regions of the Old World. The *Bandicoot*, or great Rat of the Plains (*M. giganteus*) does not exist in Nepal;† but various kinds of Field Mice, of what precise species is not mentioned, are stated to be sufficiently common.‡ The Porcupine (*Hystrix cristata var. leucarus*, Sykes) is found in Kemaon,§ and the lower and central regions of Nepal.||

Mr. Hodgson¶ mentions two species of Hares as inhabiting Nepal. One he calls the common small species (probably the black-necked Hare of F. Cuvier, '*Lepus nigricollis*'), which, he says, is confined to the Turaï; the other, which he considers a new species, as large as the common English Hare and nearly resembling it, inhabits the higher and colder parts of the mountains. This is *probably* the red-tailed Hare of M. Isidore Geoffroy St. Hilaire,** (*L. ruficaudatus*), of which Dr. Royle obtained a specimen at Hurdwar (?) and which, he informs me, is very common in the Doon and in the neighbourhood of Delhi. As M. Is. Geoffroy's short description of this species is necessarily imperfect, from the mutilated state of the only skin which he had an opportunity of examining, the following more detailed account will not be unacceptable to the scientific Zoologist:—

The skin obtained by Dr. Royle is that of a full-grown female; it is in perfect condition, and measures one foot ten inches from the nose to the origin of the tail: the ears are about five inches in length, and the tail four inches. The face, back and sides are regularly brindled, or varie-

* Proc. Zool, Soc., ii. 98.

† Asiat. Res., xvi. 153.

‡ Richardson Faun. Bor. Amer., i. 140-1.

§ Journ. Asiat. Soc., v. 234.

|| Proc. Zool. Soc., ii. 97, 98.

¶ Traill in Asiat. Res., xvi. 153.

** Dict. Class., ix. 381.

gated with alternate wavy lines of black and light sandy brown, arising from the hairs on those parts being annulated with these two colours. The whole coat is short, smooth and glossy; it consists of a short fine internal fur, of a cottony texture, and pale bluish white colour, and of a long, coarse, external hair, which, as just observed, is annulated with black and light sandy brown, and gives the general colour to the upper parts of the body. In the distribution of these colours, each hair is divided into three equal parts, the top and bottom being black, and the centre light reddish brown. The dark colour predominates most on the face, hips, and along the median line of the back, but becomes gradually fainter upon the shoulders and flanks, and is separated from the pure white of the belly by a narrow band of pale rufous. The cheeks are grey, pointed or intermixed with black; a light grey spot occupies the space in front of each eye; the chin is also grey, and the moustaches long and stiff, black at the roots and grey at the points. The ears *appear* to be reddish brown tipped with black, but the hair has been partly rubbed off in the specimen described, which prevents me from speaking with certainty. The whole upper part of the neck is pure unmixed sandy red, the fur being of the same quality as the internal fur upon other parts of the body, and without any intermixture of the long external silky hairs. The outer face of the arms, the whole of the fore legs, and the outer face of the hind, are also red; the tail red, or rather reddish brown above, and pure white beneath; and the belly and under parts of the body unmixed white. The animal had probably been killed whilst suckling her young, as the skin exhibited four very large teats, one pair on the breast and the other on the abdomen. These were all I could observe, but there may have been more, as the skin had been a good deal rubbed about these parts.

But by far the most interesting and unexpected acquisition, which Dr. Royle's discoveries among the Himalayas has produced to the Zoologist, is a new and beautiful species of *Lagomys*, a genus heretofore only found in Northern Asia and among the rocky mountains in North America. This discovery, of the greatest importance to our inquiries into the principles which regulate the geographical distribution of animals, is entirely due to Dr. Royle, and furnishes another, and a most glaring instance of the paramount influence of climate upon the dispersion of animals, as well as vegetables. Unfortunately, the only skin which Dr. Royle has brought to England, is too imperfect to admit of so detailed a description as would be desirable. The skull has been taken out, (it is now in the Museum of University College, and, Professor Grant informs me, exhibits the same form of dentition as the other species of Lagomys des-

cribed by Drs. Pallas and Richardson), and the hind legs cut off, but in other respects it is in a sufficiently good state of preservation to enable me to assign its specific characters. I propose, under the specific denomination of *Lagomys Roylii*, to dedicate it to my friend Dr. Royle, in commemoration of the important service which that distinguished Botanist has rendered by its discovery to the kindred science of Zoology.

The *L. Roylii* more nearly resembles the *Sulgan* (*L. pusillus*, Pallas), and the American species (*L. princeps*, Richardson), than either the *Pica* or *Ogotona* (*L. alpinus* and *Ogotona* of Pallas). With the exception of the *Pica*, however, it is considerably larger than any other species of *Lagomys* : the skin here described, notwithstanding its imperfect state—for the hinder parts have been partially mutilated, measuring eight and a half inches in length, which is more than one-third as large again as the *Ogotona*, *Sulgan* or American species. From the *Ogotona*, however, it is easily distinguished by its colours, which, in that species, are light grey above and pure white beneath, as well as by its naked soles. The triangular form of the ears in *L. pusillus*, prevents that animal from being confounded with any other species, and the *Pica* (*L. alpinus*), which alone approaches the size of *L. Roylii*, is at once distinguished by the sandy red colour of its fur. The *L. princeps* of Dr. Richardson is the only remaining species of the genus at present known ; it is very similar to our animal in the colour and quality of the fur, but may be readily distinguished by its inferior size, and by the deep black hair which covers the external surface of its ears, and which is replaced in *L. Roylii* by long fur of a pure white colour.

The fur of this species is of two kinds, a very soft and fine internal one of a beautiful blue black over every part of the head and body, as well above as below, and a coarser external kind, of the same colour at the base, but afterwards marked with a broad ring of a greyish yellow colour, and finally tipped with dark brown. These two kinds of fur, however, are not produced by an actual difference in the individual hairs ; on the contrary, the same hairs exhibit both the appearances here described, being extremely soft and fine at the root, and assuming a harsh and rigid structure towards the extremity. These harsh tips, being the only parts of the fur seen from without, give their general colour to the whole body. On the upper parts of the body, the head, back and sides, this is uniform brown, slightly mixed with yellowish grey, very dark on the back, much more so, for instance, than in the common Rat (*M. Decumanus*), but rather paler on the sides, and yellowish white on the belly ; the hairs on this part wanting the harsh brown point, though in other

respects perfectly similar to those of the back. The fur on the body is about an inch in length, and nearly as long on the head, which gives the face a rough shaggy appearance. The nose is entirely covered with short harsh hair of a uniform brown colour; the upper lip is bilobed as in the Hare; the ears are of an elliptical form with regularly rounded tops, covered internally with very short brown hair, and on the outside with long white hair at the base, and short brown at the top, the posterior edges having a scarcely perceptible narrow white border. They are about half an inch broad and three quarters of an inch in length, with a small internal lobe about a quarter of an inch long, and have the folding inwards of the anterior margin, and, consequently, the resulting funnel shape of their basal portions, which Pallas noticed in the species of Northern Asia. Dr. Richardson could observe nothing of this appearance in his *L. princeps*, but I presume this must have arisen from the imperfect state of his specimens in a part so liable to be injured, since an individual in the British Museum exhibits the structure too obviously to have otherwise escaped the notice of that accurate Zoologist. The vibrissæ of *L. Roylii* are nearly as long as the head and ears together, and of a uniform brown colour. The arms and fore-arms, and, I presume, the thighs and legs, for, as I have already observed, the posterior members are wanting in the specimen, are covered with fur of the same colour and quality as that on the body, only shorter; but the whole upper face of the carpus, and probably also of the tarsus, is covered with short adpressed hair of a bright reddish yellow colour. The soles of the fore feet present four naked tubercles, corresponding to the extremities of the toes, and a fifth, considerably farther back, which represents the heel, and is separated from the others by a space covered with very short brown hair. The thumb is situated behind the other toes, and, like them, has a small sharp claw of a dusky horn colour.

Dr. Royle obtained his specimen on the Choor Mountain. I take it to be this animal which Captain Mundy* met with during his interesting tour recently published, and which he describes as something between a hare and a guinea-pig; and it is probably, also, the tailless rat which Turner† observed in Thibet, where the banks of a lake were everywhere perforated by its burrows.‡

* Tour in India, II., 196.

† Journey to Thibet, 211.

‡ I have since seen perfect specimens of this animal, but have nothing to add to the description here given.

EDENTATA.

Of this family, the only species known to inhabit the Continent of Asia, the short-tailed Manis, or Scaly Anteater of authors (*Manis pentadactyla* of Linnæus, *M. macroura* of Desmarest) is found in the lower and less elevated parts of the central regions: but all the *Edentata* are essentially inhabitants of the warmer parts of the earth, more especially of tropical America, and we cannot therefore expect to find their forms reproduced in the Himalayas. Mr. Hodgson has described the Manis of Nepal as a new species, under the name of *M. auritus*,* on the supposition of its being distinct from the common species of the plains of Upper India, the *Badjarkita* of the Bengalese (*M. macroura*), which has been known ever since the expedition of Alexander the Great, and is mentioned by Ælian under the name of Φαττάγης; but Mr. Hodgson in this, as in many other instances, has been misled by Griffith's Translation of the *Regne Animal*, a compilation which has obtained a much greater authority in India than its merits entitle it to, or than it enjoys at home.

PACHYDERMATA.

The great Saul Forest, which extends for many hundred miles along the bases of the Himalayan Mountains, affords shelter to vast multitudes of animals, of which it is probable that many species still remain undescribed. Among other genera, the large *Pachydermata* abound in these situations; the Elephant and Rhinoceros (*Elephas indicus* and *Rhinoceros unicornis*), are extremely numerous; and in the rainy season, or in times of scarcity, make frequent inroads into the lower hills, and commit great depredations among the crops of the natives. The Indian Rhinoceros affords a remarkable instance of the obstructions which the progress of knowledge may suffer, and the gross absurdities which not unfrequently result from the wrong application of a name. This animal, to whose horn the superstition of the Persians and Arabs has in all ages attributed peculiar virtues, became known to the Greeks through the description of Ctesias, a credulous physician of that nation, who appears to have resided at the court of Persia in the time of the younger Cyrus, about 400 years before the birth of Christ. His account, though mixed up with a great deal of credulous absurdity, contains a very tolerable and perfectly recognizable description of the Rhinoceros, under the ridiculous name, however, of the *Indian Ass;* and as he attributed to it a whole hoof,

* Journ. As. Soc., V. 234.

like the horse, and a single horn in the forehead, speculation required but one step further to produce the fabulous Unicorn, such as it appears in the royal arms of England, and such as it has retained its hold on popular credulity for the last two thousand years. The works of Ctesias have perished, but this curious passage is preserved by Phocius;* Aristotle† adopted his statements regarding the *Indian Ass*, from Ctesias; and no other passage of his writings has given rise to a tenth part of the commentaries, discussions, and speculations which have originated in this. Religion was, as usual, pressed into the discussion, and as the Septuagint had used the word *Monoceros*, it was at one time next to rank heresy to doubt the existence of the Unicorn, and might have brought the imprudent sceptic to the stake. But it is not my intention to renew this fruitless and childish discussion; my only wish is to point out the perfect applicability of Ctesias's description to the Indian Rhinoceros, as it is now well known to naturalists; those who wish to pursue a subject of considerable interest in the history of human knowledge, will find many curious details in the writings of the learned Bochart,‡ in Scaliger, Hardouin, Sivry, and others of the older commentators on Aristotle and Pliny.

Wild Hogs, but of a smaller variety than those of Bengal, are extremely numerous in all the wooded parts of the mountains; they do not appear to be specifically different from the common wild boar of Europe. Horses do not breed on the southern face of the mountains, but are imported from Thibet.§ A valuable and sure-footed variety, called Tangun, is described by Turner.|| The Ass does not appear to have been introduced into any part of the mountains, at least neither Dr. Hamilton nor Mr. Hodgson makes any allusion to its being found in Nepal,¶ and Mr. Traill expressly states that it does not exist in Kemaon.** The Dziggetai, however (*Equus hemionus*), is found on the plains of Thibet and Tartary, and is called *Kiang* by the natives.

RUMINANTIA.

The Ruminantia of the Himalayas, as composed of the larger four-footed game most commonly followed by sportsmen, are probably better known than any other department of Hill Mammalogy. Yet even here much still remains to be done to make us thoroughly acquainted with all the different species or varieties which have been mentioned by Mr. Hodg-

* Photii Biblioth. cod., 72, p. 91.
† Hist., lib. ii., c. 1.
‡ Hierozoï, lib. iii., c. 26.
§ Mundy's Tour. ii., 75.
|| Fraser's Journey, p. 351.
¶ Hamilton's Nepaul, 79.
** Journey, 21.

son* and other writers; the nomenclature, in particular, is extremely confused, and there is strong reason to believe that the number of species, particularly among the deer tribe, has been greatly increased by the variety of names given to the same animal in the ever varying dialects of the hill tribes. I have, however, only mentioned those of which the existence is known with some degree of certainty.

The Musk (*Moschus moschiferus*), called Kastooree, is not uncommon in the higher hills. It is said to derive its peculiar odoriferous secretion from feeding on the Kastooree plant, a kind of ground nut, which is strongly impregnated with the same pungent scent, and which the animal digs up with its long tusk. Mr. Hodgson, in a recent number of the Journal of the Asiatic Society,† expresses his belief in the existence of three different species of this animal among the Himalayas, and even assigns them distinct names; but the characters are founded entirely on the difference of colour, which is too variable to be depended on for the purpose of specific distinction; and, in fact, Lieut. Smith assures me that the colours vary with the age of the animal; a remark on which I am disposed to place the greater reliance from its agreeing with my own observations, made on many individuals preserved in the museums of this country and the Continent. Whether the "Second species of Musk," mentioned by Dr. Falconer as having been discovered during his recent journey into Cashmere and Little Thibet, be founded on more important characters, we have no means of ascertaining, that Naturalist not having yet published his observations.

Of the genus Cervus, the Chittra or Spotted Axis (*C. axis*), and the Laguna or Pâra and Sûgoriah, called also *Jhou Laghuna* and *Khar Laguna*, or spotted and brown varieties of the Hog-deer (*C. porcinus*) are common in the lower hills and forests, but do not ascend the mountains. The specific distinction or identity of the two latter animals has long been a subject of dispute among naturalists; Lieut. Smith believes that the spotted variety is only the young; but I have myself seen animals at least three or four years old, with a row of spots on each side of the spine, though, at the same time, I do not believe them to be distinct from the plain coloured or common brown variety, with which they perfectly agreed in every other respect. The subject is worth the attention of those who have an opportunity of settling the question. Three other species of the Axine group of deer are mentioned by Mr. Hodgson, under the collective name of Jaraï, but individually distinguished by the Nepalese as the Phûsro, Râto, and Kâlo, or hoary, red, and black Jaraïs res-

* Asiat. Res., xvi., 351. † New Series, I., 202.

pectively. The two former have been identified with the *Cervus Hippelaphus* and *Cervus equinus* of Cuvier, the latter certainly without foundation, and the former at least very doubtful; the third, said to be undescribed, is probably the *C. Aristotelis* of Cuvier; but the truth is, that we know very little about them, nor are these different species mentioned by any other author besides Mr. Hodgson. The *Cervus Hippelaphus*, indeed, called *Saumer* or *Sambre* in the Plains, is well known in this country, where he has long existed in our menageries, and is probably the *C. Aristotelis*, which is familiarly called *Elk* in the Hills, and of which the native name in the British hill provinces is *Jerow* for the male, and *Maha* for the female, names which have been not unfrequently applied to different species; of the Phûsro, or Hoary Jarai of Mr. Hodgson, which, whatever else it may be, is certainly not the *C. equinus*, since that species does not inhabit Continental India, nothing is known but the name, if, indeed, it be not a mere variety of sex or age. Lieut. Smith describes the Jerow of the Hills as a larger and heavier animal, and with finer horns, than the Saumer of the Plains: the tan and black colours of these two species appears to identify them with the Râto and Kâlo Jaraïs of Mr. Hodgson.

No fewer than three species of deer, with characters approaching to those of the common stag (*C. Elaphus*) of Europe, have been mentioned as inhabitants of Nepal. Two of these, the *Cervus Wallichii* and *Cervus Duvaucellii* of Cuvier, are known, though not so perfectly as could be wished; the third, which has been identified with the common stag, appears to be founded upon error. Mr. Hodgson has briefly described the *Cervus Duvaucellii* under the name of *C. Elaphoïdes*, and I have seen a full-grown male in the Zoological Gardens; the comparison of the skull figured by Mr. Hodgson* with the horns in the *Ossemens Fossiles* leaves no doubt as to the identity of the species. It is called in Nepal *Baraïyo*, and, according to Mr. Hodgson, *Maha* in the Western Hills, a name which, as observed above, Lieut. Smith applies to the female Jerow. *Cervus Wallichii*, called *Barah Singha*, is mentioned by Mr. Walter† as an inhabitant of the mountains of Silhet, and by Mr. Hodgson,‡ who confounds it with the common stag, as found in the Saul Forest, which skirts the foot of the Nepal Mountains, whence it was originally sent to Calcutta by Dr. Wallich. There is no grounds for supposing the existence of a third species of this group in the Himalayas, identical with the Red Deer of Europe (*C. Elaphus*), though the

* Journ. Roy. As. Soc., IV., 648. † Asiat. Res., xvii., 499. ‡ Loc. Cit.

fact is distinctly stated both by Duvaucel and Mr. Hodgson :* these authors appear to have mistaken the *C. Wallichii* for that animal, though the specific distinction was afterwards well known to Duvaucel, who sent to Baron Cuvier the description published in the "Ossemens Fossiles." Dr. Falconer mentions the discovery of a new species of deer in the Report of his recent Journey to Cashmere and Little Thibet,† and Dr. Royle has figured (tab. 5, fig. 1) a female under the name of *C. Dodur*, by which it is known about Saharunpore. He describes it as being about the size of the female Hirn (*Antilope cervicapra*), lighter and more graceful than the Hog-deer, and of an ashy brown colour ; but this is all I know of the animal, nor do I find it even mentioned by any other writer. It appears to be unquestionably a new species, and is well worth the attention of Indian naturalists.

Of the *Muntjac* tribe of deer, I am acquainted with three distinct species inhabiting the Indian continent : one entirely black (*C. melas*), one of a light sandy fawn colour, probably the *Ratwa* of the Nepalese (*C. ratwa*, Hodg.), and the third the common Muntjac, called Kacker by the natives, and Barking Deer by the Europeans (*C. Muntjac*, Lin.), of a deeper bay and much smaller size than the *Ratwa :* the former is scarcely the size of the Roe-buck (*C. Capreolus*) ; the latter nearly equals the Fallow Deer (*C. Dama*, Lin.). Dr. Royle has figured the "Barking Deer" of the North Western Himalayas, v. tab. 5, fig. 2, under the name of *Cervus Rutwa*, conceiving it to be identical with Mr. Hodgson's species. All these animals may be readily distinguished from the other species of Deer, by their long projecting tusks, horns mounted upon long bony pedicles, and the glandular folds of skin on the forehead. They require, however, to be more attentively examined, and compared with one another.

Of *Hollow-horned* Ruminants, the *Ghoral* and *Thar* (*Antilope Ghoral* and *A. Thar*), are now pretty well known from the researches of Mr. Hodgson, who has set a praiseworthy example to our Indian countrymen, by the laudable zeal with which he perseveres in illustrating the Zoology of Nepal. Both these species are proper to the middle and northern regions of the Hills. The Thar of Mr. Hodgson is universally called *Surow* and *Imoo* in the more western parts of the mountains, the latter name predominating in the higher, and the former, in the lower hills : the name of Thar, according to Lieut. Smith, is there applied exclusively to the species of goat which Mr. Hodgson calls the *Jharal*. That beautiful and stately antelope, the *Chiru* (*A. Hodgsonii*), of which our

* Asiat. Reg., xv., 120.

† Journ. Asiat. Soc., iv., 710.

knowledge is entirely due to Mr. Hodgson's researches, is confined to Bhot, Thibet, and the surrounding countries; it appears to be altogether unknown on the southern face of the Mountains, except from an occasional specimen imported by the traders, either for presents or barter. The common Indian antelope, called *Hirn*, and the *Chickarra*, or four-horned species (*A. cervicapra* and *quadricornis*), are confined to the lower hills and forests, and the *Neel-ghau* (*A. picta*) principally to the plains and jungles of the north-western districts. Mr. Colebrooke says that, in the opinion of the Hindoos, the resort of the Antelope sanctfiies the countries graced by his presence, while his absence degrades the regions which he avoids. This seems more connected with physical observation than with popular prejudice. The wide and open range in which the Antelope delights is equally denied by the forests of the mountain and by the inundation of the fens.* These are the only antelopes of which we have any precise knowledge, as inhabitants of this part of India; but it is probable that others still remain undescribed. Captain Herbert,† in his "Tour to the Sutlej," mentions two animals by the names of *Skin* and *War*, the accounts of which do not agree with any known species, and which are therefore well worth the attention of future observers. The *War*, according to Capt. Herbert, is somewhat like the *Musk Deer* (*Moschus Moschiferus*), but with a face more like that of a sheep, divided hoofs, and horns more nearly resembling those of a buffalo than of any other animal; a description which, in spite of the similarity of names, is inapplicable either to the Thar or Jharal, though indeed, little dependence is to be placed in the descriptions of unscientific observers.

The *Neel-ghau* deserves a more particular notice, for the purpose of clearing up a point in its history, equally interesting to the Classical Scholar and to the Zoologist. It has been already observed that Modern Naturalists, after the example of Baron Cuvier, have identified the great *Saumer Deer* of India with the animal which Aristotle describes by the name of *Hippelaphus*. "The *Hippelaphus*," says the Greek philosopher,‡ "has also a mane, (he is talking of the mane of the Horse), above the shoulders, but from this to the head along the top of the neck *it is very thin*; it has likewise a *beard on the larynx*;......it is about the size of the Stag......the female has no horns......those of the male resemble the horns of the *Dorcas* (*A. Gazelle*)......it inhabits Arachosia."

* Colebrooke on Bengal Husbandry. † Asiat. Res., xv., 397.
‡ Hist. lib. II. c. 5.

Any one acquainted with the *Neel-ghau* will readily perceive the applicability of this passage to its most obvious characters: in fact Aristotle's description of this animal, under the name of *Hippelaphus*, is more exact and minute than the description of any other animal mentioned in his history; it is evidently taken from personal observation, and it is surprising that the application should have hitherto escaped the penetration both of critics and Zoologists. The older naturalists, such as Gesner and Aldrovandus may be excused for misapplying the passage in question, sometimes to the Elk, sometimes to the common Stag in his winter-dress, when the hair of the neck becomes longer than ordinary, since they were unacquainted with the form and characters of the *Neel-ghau;* but the continuation of the mistake by their successors, to whom the animal has been long familiar, is altogether unpardonable. This identification, indeed, was absurd enough from the beginning: the habitat of Arachosia, and the assigned form of the horns, were alone sufficient to distinguish the Hippelaphus from either the Elk or common Stag, independently of the critical absurdity of supposing Aristotle to describe such well-known animals at such length and under a new name: but the truth is, that all modern commentators have been misled by a wrong translation of the term Δορκας, employed by Aristotle, as the name of an animal, to the horns of which he compares those of the Hippelaphus. Now, it is to be observed that the Dorcas of the Greeks and Romans is universally admitted to be the Gazelle of Egypt and Northern Africa, as may be easily proved from many passages in Herodotus and other ancient writers. Theodore Gaza, himself a Greek, and the first translator of Aristotle, very properly renders the word by *capra*, but Buffon* having criticised Gaza's *ignorance*, and affirmed that the word should really be translated *caprea*, every body has since followed the translation of Buffon, and the *Dorcas* of Aristotle has been accordingly considered identical with the *Roe-buck*, whilst the *Dorcas* of all other ancient writers is acknowledged to be the *Gazelle*.

This seems to have been one of the principal sources of error which misled Baron Cuvier, after the example of his predecessors, to identify the Hippelaphus of Aristotle with a species of Deer. The head and skin of the large Indian *Saumer* had been sent to Paris by Diard and Duvaucel; the hair of the neck was observed to be considerably longer and coarser than that on the rest of the body, the horns had only two antlers, *like those of the Roe-buck*, and it came from India. Baron Cuvier immediately concluded that he had discovered the real Hippelaphus of

* Hist. Nat. XI. 402.

Aristotle, and takes considerable pains to prove it.* Against this opinion of the most distinguished of modern naturalists, however, I have to urge objections as grave as those which lay against the ancient error which identified the *Hippelaphus* with the Stag and Elk. In the first place, as I have just shown, the fancied similarity of the horns of the *Hippelaphus* to those of the Roe-buck, arises from a false translation of the word *Dorcas;* when this term is properly translated, *Gazelle*, the horns of the *Hippelaphus*, to be similar to those of the *Dorcas*, should be small, round, and *without branches;*—such are the horns of *Neel-ghau*, and such are not the horns of the Saumer. In the second place, the *Saumer* Deer has certainly longer and stiffer hair on the neck than elsewhere, but it is equally long and rough *over the whole neck, as well on the sides as above and below*, and has no resemblance whatever to the mane of the Horse and Mule to which Aristotle compares it. In fact the description of Aristotle does not apply to it in any particular. *The Saumer* does not show the least appearance of the *thin mane along the top of the neck, longest and thickest on the shoulders;* neither has it anything that can be called a beard, distinct, at least from the general roughness of the neck which Baron Cuvier calls its mane. But even allowing the rough hair on the under surface to be called a beard, still Aristotle's description does not apply, for this rough hair covers the *whole throat* in the Saumer from the head to the chest, whilst the Greek philosopher restricts the beard of the *Hippelaphus* to the *Larynx*, and this is precisely the situation in which the long bunch of coarse hair, nearly a foot in length, is found on the throat of the *Neel-ghau.* In fact there is not a single point, even to the most minute particular, the habitat of Arachosia, for instance, the modern Punjab, where the Neel-ghau is extremely abundant, and where the Saumer does not exist, at least we have no evidence of the fact,—in which Aristotle's description of the Hippelaphus does not perfectly agree with this now well-known animal; and we may therefore safely conclude that we have at length finally settled a question which has long puzzled both critics and Zoologists. The *Neel-ghau* should consequently assume in future the specific appellation of *Antilope Hippelaphus*, whilst the Saumer Deer, to which that name has been erroneously applied, may be more appropriately called *Cervus Saumer.*

Two distinct species of the genus Capra occur in the Himalayas: *Capra jemblaïca* of Hamilton Smith, called *Jharal* in Nepal, and *Thar* in the British provinces, is by far the more common of the two, and is

* Oss. Foss. IV. 42.

stated by Mr. Hodgson* to differ from other goats by having four teats. The second species has never been described, but its existence is placed beyond a doubt; Major Kennedy, while resident at Simla, had two stuffed specimens, procured in the neighbouring mountains, and the animal is mentioned by various tourists under the name of the Ibex, which it appears to resemble in the form of the horns and other characters. Dr. Falconer, in the Report of his late Journey to Cashmere and Little Thibet, mentions the discovery of two new species of goats; but as he does not enter into any detail on the subject, we have no means of ascertaining how far they may prove to be identical with, or different from, the two species here mentioned. Different varieties of the domestic goat, the most valuable of which are the *Changra*, or shawl goats, of two breeds, distinguished as the larger and the smaller Changra, are found in the more alpine regions; their wool forms an article of extensive traffic, but we are much in want of detailed comparative descriptions and good figures of these, as of all the different breeds of cattle and other domestic animals in India; a subject of great interest, which has been extensively illustrated at home, but which has met with little or no attention out of Europe.

Of sheep there are likewise two wild species, and numerous domestic varieties, found in these mountains. The *Burrhal*, called *Nahoor* by the Nepalese (*Ovis Nahoor* of Mr. Hodgson), is intermediate in character between the Mouflon (*O. Musmon*) of Corsica, the supposed parent of our domestic sheep, and the Aoudad (*O. tragelaphus*) of Northern Africa, which latter species it resembles in the form of the horns and the absence of the crumens, or tear-pits, which distinguish the rest of the genus. The second species, called *Banbhera* in Nepal, is less known, but appears to approach very nearly to the Argali of Siberia (*O. Ammon*), if, indeed, it be not identical with that animal. I have seen the skull and horns in the Museum of the Royal Asiatic Society, to which it was presented by Sir Alexander Burnes; but as there is no specimen of the Argali in this country with which to compare it, I can offer no opinion as to its specific difference. The animal seems to be more properly a native of Thibet and Chinese Tartary, and seldom appears on the southern part of the Himalayas; at least none of my sporting acquaintances ever met with it, and Mr. Hodgson was long doubtful of its existence. Of the domestic sheep of the Hills, besides the Dûmba, or common variety of Upper India, Mr. Hodgson mentions a breed called *Barwal* as occurring in the Kachar, and another called *Hoaniah*, peculiar to Thibet: these are used as beasts

* Journ. Asiat. Soc., iv. 710.

of burden for carrying grain and other products across the mountains, but we know little of their peculiar forms or qualities.

Of the genus *Bos*, the buffalo (*B. Bubalus*), and its representative, the *Arnee*, or *Urnee Bhinse*, are confined to the sultry forests at the foot of the mountains. The latter is a very distinct variety, if not a different species, from the *Junglee Bhinse* of Bengal and Assam, so well known for the great length of its horns; the *Arnee* of the Saul forest is the short thick horned variety, of which there are many skulls, preserved in our Museums, and is said to be a much lighter made animal, though with a thicker skin than the *Junglee Bhinse*. The Zebu (*Bos indicus*) is common in every part of the Hills; but the peculiar and appropriate species of the Himalayas is the Changree, or Yak (*Bos pœphagus*, Pallas), which composes the domestic cattle of Tartary, and is not uncommon on the southern slopes of the higher Mountains, where a cross between it and the Zebu, or common Indian Ox, is much used in agriculture, and preferred to either of the pure races. This hybrid is not uncommon at Simla, and it is to be hoped that some intelligent observer will take advantage of this circumstance to ascertain from actual experiments whether the sexes be productive *inter se*, or when united with one of the pure races; or whether, like the common mule, they be absolutely barren. Lieut. Smith informs me that he has seen the Yak wild on the confines of Chinese Tartary.—*Royle's Illustrations of the Botany, &c. of the Himalayan Mountains, Supplementary Part.*

Art. X.—*Beryl Mine of Paddioor, and Geognostic Position of this Gem, in Coimbatoor, Southern India.—By* Lieut. Newbold, *Madras Army, A. D. C. to* Brigadier-General Wilson, C.B.

The Beryl mine of Paddioor, or Patialey as it is sometimes termed, is situated at the eastern extremity of a village of the same name, in the Kanghyum Taluk, in the Coimbatoor Collectorate, about forty miles E.N.E. from the town of Coimbatoor, which lies in Lat. 11° N., and Long. 77° 1′ E. The surrounding country is an undulating plain, studded with a few short clusters of hills, principally of gneiss and quartz rock. The surface of the plain is intersected by a few ravines and rivulets, flowing towards the Noel river, which, rising in the Nilgherry Chain, pursues an easterly course to the Cauvery. The latter river flows through the midst of this great plain, which is bounded by the Nilgherries to the west, and

the Shevaroy and Salem Mountains to the east. All these ranges consist of normal rocks, principally gneiss, hornblende-slate, and mica-slate, associated with granite, greenstone, and basalt in dykes. The rocks that occur in the plain are of a similar description, with beds of quartz distinctly stratified, sometimes highly ferruginous, and passing into garnet rock. Garnets, regularly crystallized, often occur in the gneiss and hornblende slate. Primitive crystalline limestone and a talcose rock occur, though rarely, interstratified with the gneiss and hornblende slate. A remarkable feature is the prevalence of basaltic dykes, accompanied by large travertine and tufa-like deposits of carbonate of lime. The influence exerted by these dykes over crystalline and metalliferous developments in these districts is interesting and instructive. Dykes, or veins, of a porphyritic granite too, traverse the gneiss in various directions. The larger veins are generally from W. to E., varying a few degrees to the S. of E. The metallic ores and minerals found associated with these rocks are chiefly the magnetic or black iron ore, disseminated and interstratified with quartz rock in a state of great purity. It sometimes occurs in octahedral crystals, with a whitish micaceous looking *enduit.* Both varieties are often highly magnetic with polarity. Manganese also occurs in the form of the black oxide; also garnets, corundum, magnesite, nephrite, asbestus, chromate of iron, adularia, pyrites, &c. Rubies have been found associated with the corundum which occurs imbedded in gneiss. I am not aware that the other beautiful variety of rhomboidal corundum, viz. the sapphire, has ever been discovered; but, from certain indications, I should be led to suppose its existence. Gold-dust is found in many of the rivulets flowing down the sides of the Nilgherry and Salem Mountains.

I will now proceed to describe the bed, and minerals with which the Beryl is more immediately associated in the particular locality which has already been adverted to, viz. Paddioor. The mine has been sunk through a bed or dyke in the gneiss and mica-slate on the line of contact; it is about eighteen paces long, by fourteen broad; it has about seven feet of water covering the lower part, and is about twenty-four deep to the surface of the water. The dyke is composed of a highly crystalline porphyritic granite, the component minerals of which are generally beautifully characteristic and distinct. The quartz is sometimes regularly crystallized, but usually in amorphous translucent masses, imbedded in large tabular crystals of pale rose-coloured felspar, with cleavlandite, garnet, and white, black, and bottle-green mica. A crystallized pyramidal prism of quartz that had been dug out of this mine measured 2 feet 3½ inches in length, and 1 foot 3 inches in diameter; it had, however, been fractured, and four only of the sides were tolerably perfect. The

mica occurred both in six-sided tables and in large irregularly-shaped nests, one of which measured 2 feet in length; the laminæ highly elastic and transparent. A few of the garnets were crystallized in dodecahedrons, sparingly disseminated in the rock; one of these crystals measured 2 inches in diameter. The crystals of cleavlandite were remarkably fine, and characteristic of this beautiful variety of felspar. The various minerals composing this bed pass from the porphyritic structure into a curiously fibrous arrangement: the quartz, felspar, and cleavlandite occurring in alternate prismatic laminæ; sections of this rock, at right angles with the long axis of the prisms, exhibit on their surfaces the appearance of graphic granite. Where this arrangement is observed, the mica is partially and irregularly distributed in thin pyramidal nests, rarely in direction with the laminæ of the rock. The quartz and felspar, where they meet with a large nest of mica, usually lose their laminar structure, becoming confused and lumpy. The felspar and cleavlandite is both white and translucent, and opaque and reddish; the latter is often crossed by microscopic fissures, inclined at a great angle to the axis of the prism. Ghunpore, in the Nizam's dominions, is the only other locality in India where I have met with this fibrous rock; it was there also associated with gneiss and granite. The cleavlandite often occur in large masses, with small cavities partly formed by the decomposition of the rock, and partly by the intersection of the longer and more distinct crystals of the cleavlandite; it is in this gangue, and in these cavities, that the Beryl, or aquamarine, is almost invariably found, in long deeply striated hexahedral prisms, with small crystals of quartz.

The whole of the rock, composing the dyke, is divided by seams, almost horizontal, intersected by fissures, thus dividing it into cuboidal masses. Many of the seams are filled by a whitish earthy incrustation of carbonate of lime, that has a tendency to collect in nodules. The larger calcareous veins attenuate as they ascend in the rock, and appear to have penetrated it from below, rather than to have been deposited from above. On reaching the surface, which it often overspreads, in beds of great extent, underlying the present soil, it assumes a closer texture, with a nodular or pisiform surface, the interior having a spheroidal structure, not unfrequently assimilating that of the travertine of San Filippo. It has been deposited, no doubt, by springs of water ascending through the subjacent strata, charged with carbonic acid, and holding lime in solution.

Small springs are still observed percolating upwards through the fissures of the rock; and, as they trickle over its surface, depositing a thin black crust composed of carbon, a little iron, calcareous and saline

matter; the latter contained both the muriate and sulphate of soda; which salts, and nitrate of potass exist abundantly in the soil of the adjacent district. The water at the bottom of the mine is sufficiently pure for irrigation and the purposes of life.

There are marks of other excavations in this vicinity, and in the same bed. The natives, however, assert their perfect ignorance of their use. Judging from the high barren situation in which I found them, these excavations could hardly have been made for wells. Blocks of the cleavlandite, which forms the matrix of the gem, had been thrown out, and evidently broken up in search of what it might be supposed to contain. The excavations were shallow, but extensive, and the quantity of the broken up gangue very large; it (the cleavlandite) can be traced in the rocks in the vicinity to an extent, east and west, of about thirty-eight miles; and it is likely that, in ancient times, antecedent to Mahomedan conquest, when rights to landed property were more secure, the gem was obtained in abundance. Now, the surface veins appear to be completely exhausted in all the excavations I examined; but it is probable, from the inquiries I made, that it is still secretly procured by natives from certain localities in this district, as it still forms an article of traffic in Indian bazaars. It has been thought, with some reason, that the largest crystallized Beryl ever known, weighing six ounces, and costing £500, and which was supposed to have been brought to Europe from Ceylon, was the produce of the Beryl mines of Coimbatoor, as neither Davy, nor any of the authors conversant with the mineralogy of Ceylon, mention its existence on that island. It has been stated positively that it does not occur there.

To Mr. Heath the merit is due of having first brought these mines under the notice of government. Mr. Fischer, the enterprising land-proprietor of Salem, informed me that the gem was first discovered by the diggers of a well on the estate of the village Potail, who sold them secretly to the itinerant jewellers and chittys, who purchased them in large quantities for a mere trifle, and sold them at an immense profit at Madras, Pondicherry, and other European settlements. This, coming to Mr. Heath's knowledge, afforded a clue by which he was enabled to trace the beryl to its situs. He lost no time in obtaining the conditional consent of government, and arranging with the native owner of the land. Mining operations were carried on for about two years, and were discontinued in consequence of the mines being exhausted, and the expense of draining off the water. It has now (1840) reverted to its original purpose of irrigation, and is still the property of the Potail who originally caused it to be dug. This venerable old Hindoo, Chin-

nana Gouda, whose hair and beard are blanched by age, paid me a visit at the mine. He informed me that it is upwards of forty years ago since he dug it; and that, until Mr Heath's discovery, about twenty-two years ago, he had not the slightest idea of the treasures contained in his own well, and of which he had been robbed for eighteen years by the people he employed.

In India, the beryl appears to be almost confined to this particular district. The natives, however, inform me that it occurs at Vaniambadi, at the northern base of the Nilgherries, in rocks of a similar age and petrographical character. In Europe it occurs also in the primitive rocks—in the granite and gneiss formations.—*Edinburgh New Philosophical Journal, October* 1840—*January* 1841.

XI.—*On the Functions of the Colouring Matter of the Skin in the Dark Races of Mankind.—By* Robert Mortimer Glover, M. D., Lecturer on Chemistry in the Newcastle-on-Tyne School of Medicine.

Various hints and hypotheses have been put forth as to the functions performed by the peculiar organization of the skin in the dark races of mankind. The opinions of Sir Everard Home, published in the Philosophical Transactions for 1821, have been generally adopted by physiologists as apparently founded on a methodical attempt to investigate the subject by direct experiment, and to elucidate it by analogical reasoning. The experiments of Sir Everard give results certainly quite opposed to what has been determined by physical observers respecting the laws which affect the radiation from, and absorption of, heat by coloured surfaces. This circumstance drew my attention to the subject, and led me to repeat some of the experiments related by Sir Everard.

It may be mentioned, before entering on the subject, that this inquiry was proposed by Lord Bacon.

The structure of the skin and of its layers is yet involved in some doubt as to many particulars; but so far as our inquiry is concerned there is no doubt whatever. It is clear that there is a spongy or vascular layer between the cuticle and true skin; or on the surface of the latter, constituting a portion of it. It is also certain that the colouring matter of the skin resides in this region. And that the intensity of shade is the greater or less abundance of the colouring matter. Hence the European

and the Negro furnish extreme instances in this inquiry; since in the one the colouring matter is in small quantity or of light shade, whereas the other has it so abundantly that in him we speak of the *pigmentum nigrum*. Between these extremes exist many curious varieties, in whom the functions of the colouring matter are well worthy of consideration, but we have data to reason only with regard to the European or White, and the Negro. Indeed, in many of the coloured races, the existence of something analogous to the dark pigment is only inferred, although the occurrence of Albinoes in all races should induce us to believe the presence of a pigment universal. So that what is said of the colouring matter in the Negro may be extended to all varieties of colour, reasoning by analogy.

It is scarcely possible to regard the dark colouring matter otherwise than as a provision for, in some way, enabling those who possess it in abundance to withstand the heat of the climate they inhabit. Accordingly, there are facts which prove such individuals to be more capable of withstanding the heat of torrid regions than acclimatized Europeans, or other whites born there. There are also facts to connect this power of withstanding excessive heat with the development of the dark colouring matter. Thus, Albinoes of Guinea, differing from both Europeans and their countrymen in this, that they totally want the colouring matter, according to many authors, are even less capable of resisting the heat of their native country than European strangers; indeed their skins are said to crack and blister on exposure to the sun's rays. And I am informed by Mr. Granidge of Barbadoes, that he has observed the same fact in that island.

Now, when we reflect that the European cannot be without some colouring matter between the true skin and cuticle, since he must differ in this respect from the Albino, it seems as if a relation were established between the development of the pigment, and probably of the rete mucosum along with it, and the power of resisting the sun's heat in torrid regions.

It is clear that in this inquiry we should regard, not merely the physical properties of the organization we consider, nor its vital properties only, but the action and reaction of the whole, and their effect on the system of the individual. For want of a consideration of all circumstances, before the publication of Sir Everard Home's views, it was not conceived how the tint, which, on analogy, should absorb more heat than any other, could, in the hottest regions of the earth, confer any exemption on its possessor. And perhaps before this paper is concluded, it

may be apparent that, since Sir Everard published, the matter has been misunderstood.

The notions entertained at present by physiologists, with regard to the operation of this pigment, are implicitly those of Sir Everard. And what they are, will appear from the following brief quotation from an elementary work:—"The secretion on the cutis vera, which gives the black colour to the skin, appears to assist in fitting men for residence in hot climates, because although such skin, by absorbing more caloric, rises to a higher temperature under the sun's rays than white skin does, yet it does not inflame so readily from a rise of temperature." Dr. Alison's meaning is, that although the skin of a negro may rise to a higher temperature under the sun's rays than a white skin in the same circumstances, yet the dark skin is less likely to inflame at *that higher temperature* than the white skin at *that lower one.* This, then, is the conclusion of Sir Everard Home, whose paper I now proceed to examine.

The paper of Sir Everard Home contains alleged facts and experiments, tending to prove the Negro more capable of withstanding excessive heat of the sun's rays than the white man, and attributing this to a supposed property in dark surfaces of destroying the scorching and blistering effect of the sun's rays. The former conclusion has already been admitted. The facts by which Sir Everard supports his second position are to be considered.

Sir Everard having fallen asleep on the deck of a vessel exposed to a tropical sun, found, on awaking, his thigh scorched through a pair of *thin* white linen trousers. From this simple observation, the extravagant conclusion is drawn of black being a better protection against the sun's rays than white.

An experiment is next related, in which Sir Everard found, on exposing his hand to the sun's rays for 45 minutes, while a thermometer attached to it stood at 90°, that blisters rose and coagulated lymph was exuded. I have attempted to produce the same effect by the concentrated rays of the sun at the same temperature indicated in a similar way, and kept up to within one or two minutes of the time, when my patience was exhausted, without any result except slight reddening. Six years ago, while off the coast of Algiers, I sat for half an hour immoveable in the sun, having the greater part of my face exposed, the thermometer in the sun's rays being considerably above 100°, and though my face was scorched, nothing like the effect described by Sir Everard took place.

Sir Everard next attempted to compare the inflaming and blistering power of the sun's rays with that of hot water. He says, that water at the temperature of 120° was painful to the body, and became unbearable

when still further heated. From this experiment and the preceding, he wishes us to infer a power of vesicating in the sun's rays not in proportion to their temperature.

In a third experiment, he exposed the backs of his hands to the sun with a thermometer on each, the one hand being uncovered, while the other had a covering of black cloth under which the thermometer was placed. After ten minutes, the degree of heat on each was marked, and the state of the surface examined, and this was repeated three times. During the last trial, the thermometer which had its ball covered by the cloth stood at 106,° while the other was at 98.° The exposed hand was scorched, that covered was unaffected in all the trials. I have not repeated this experiment because it is subject to an obvious fallacy, for the ball of the thermometer being between the cloth and the part, a space intervened, and across this space the heat from the cloth could only pass by radiation or by transmission through the thermometer, but not directly from the cloth to the hand, so that the heat might not accumulate on the skin.

In a fourth experiment, a Negro bore the sun's rays on his hand when a thermometer on the part indicated 100° without any scorching being the result. As the scorching of which Sir Everard speaks could be only a slight blush, it might not be observed on a sable skin. However, I do not question the result of this experiment.

Sir Everard observed in his next experiment, during the course of an eclipse, as the darkness on the sun's disk diminished, the scorching power of the rays, concentrated by a lens, increased in a ratio which is assumed to be greater than could be accounted for by the mere rise of temperature during the time of the experiment. Whence it is to be inferred that the excess of effect is due to the increased quantity of light present with the heating rays at each advance of time. A reference to the original paper will convince the reader that this assumption is established without sufficient data.

Most stress has been laid by Sir Everard, and those who have adopted his views, on the seventh experiment. We are told that, on the 9th of September, at 11 A. M., thermometer 90° in the sun, the concentrated rays applied to a piece of black kerseymere wrapped round the arm, gave no real pain, as it is expressed, during 15 minutes; and at the end of that time left no appearance on the arm; whereas, when white kerseymere was substituted, during the same time, and the concentration we are led to suppose being the same, the heat of a thermometer in the sun only 86°, yet blisters were formed From this experiment, taken along with those preceding, it is supposed to be fully proved that although

black surfaces rise to a higher temperature than white under the sun's rays, yet they scorch the surface of the body less; the scorching effect depending on a union of the rays of heat with those of light, the latter being supposed, by way of explanation, to be excluded by the black surface. First, I shall state my repetition of the experiment, and then attend to Sir Everard's explanation of his supposed fact.

I have attempted to ascertain the rise which the absorption of heat by black and white cloths respectively gives to the thermometer; to compare this observation with the effects of the same cloths under the sun's rays upon the body, and with the effect of the sun's rays on the naked skin. When the thermometer stands at about 80° in the sun, the solar rays concentrated on white cloth over the ball of a thermometer, to a space of an inch and a half in diameter by a burning-glass, caused a rise of the thermometer to 125° in a quarter of an hour. When black cloth was substituted the rise during the same period was to 172°. In five minutes, with the white, the rise was to 108°, with the black to 140°; and in some experiments in a proportion nearer that given by the longer period.

When the black and white cloths were applied to the skin at the same temperature, and with the same degree of concentration, as already mentioned, the black cloth generally caused intense pain in the course of a few minutes, and on being allowed to remain for five or at most seven minutes, produced blisters. During the same period very little apparent effect followed the application of the white cloth, though considerable pain was sometimes produced. The experiment was at different times performed on several individuals, all of whom found the black cloth give the sensation of pain sooner than the white. On the whole, I found nothing like the difference described by Sir Everard, though certainly the vesicating effect of the black surface appeared to be much greater than that of the white. From many experiments I conclude, that the rays of the sun will scorch when they are applied to the surface so as to cause a heat of about 130° and upwards. And from the experiment related by Sir Everard, it appears that hot water is capable of producing a similar effect at that temperature. From all this, I am inclined to deny the existence of a scorching power in the sun's rays, independent of the heat they contain, or at least of the effect they produce on the thermometer. Moreover, if such a power do exist, black cloth should yet scorch more than white, since it will absorb all the rays of light, whereas the other surface will reflect them.

In those experiments which I performed, care was taken to have the white and black cloth nearly of the same density. Sir Everard does not

appear satisfied with his explanation of the extraordinary *fact* he relates, for he gives another furnished by Davy, who, indeed, is made to ascribe the alleged difference in vesicating power between black and white surfaces, to the former rendering the heat *sensible.* Were I not quoting from the Philosophical Transactions, a misprint might be suspected. I conclude that a black skin will absorb more heat than a white skin, and were it not for other accompanying circumstances, would produce inconvenience precisely in the ratio of the amount of heat absorbed. It must not be overlooked, however, that in the Negro the pigment is not superficial, but covered by a layer of translucent cuticle. The experiments of Dr. Stark prove that colours absorb heat in proportion to their depth of shade through transparent media. It only remains to show the cuticle to be a medium in the condition of those. For this purpose, I covered the balls of a differential thermometer, one with cuticle, the other with cuticle of the same thickness, having ivory black rubbed on its inner surface; on bringing the thermometer into the sun's rays, the column of liquid descended rapidly in the stem, the ball of which was covered with the blackened cuticle.

It is evident, from the result of experiments which I have related, that a much less degree of heat can be borne when the heat is applied locally, or so that the perspiratory process is not excited over the whole system, than Sir Joseph Banks and others were able to bear in heated apartments where perspiration was fully excited.

This circumstance leads me to offer an explanation of the functions, or, not to speak mincingly, of the *uses* served by the peculiar colouring matter in the dark races. Blumenbach and Dr. Winterbottom concur in stating the Negro to perspire more readily than the European or White, and Dr John Davy, in the 3d vol. of the Medico-Chirurgical Transactions, gives its due influence to this property. After noticing that the excessive perspiration in dark people must keep down the temperature, he proceeds, " In the inhabitants of the tropics, the exhalant arteries of the skin seem unusually expanded, and the whole apparatus peculiar to this secretion unusually developed; and I believe that the blood itself is less viscid, more fluid, and flows more readily through the vessels, so as to promote perspiration, and by that means contributing to the cooling of the surface, and being cooled itself, it contributes again when it flows back upon the heart, to the reduction of the temperature of the internal parts."

Were the inhabitant of the tropic not possessed of this organization, his system could not respond to the stimulus of heat, by a determination of fluid to the surface of the body. And the heat absorbed by the

skin being prevented from entering the system by the perspiratory process, the greater radiating power of a dark skin must be beneficial in cooling.

Again, the dark skin places the Negro in the conditions of his climate by causing him to radiate heat at night, and become at that time cooler than a White in the same circumstances. This is a fact which has been observed of the Negroes. Their propensity for exercise in the open air at night has been remarked. Thus we read that when the fleet of Hanno approached the shores of Negroland, the country which, during the day, presented only silent woods without the least trace of man, at night was lighted up with immense fires, while the woods resounded with the sounds of festivity. In a climate where, during the day, vegetation appears burnt up, the earth is cracked by the heat, and all living creatures languish; but where at night breezes refresh the air, and cheer exhausted nature, plants run with dew, and animals leave their haunts, man also, fitted by the structure of his skin to throw off heat, issues forth animated by the irresistible propensity to exercise which is always given by the bracing air of colder climates.—*Edinburgh New Philosophical Journal, October* 1840.—*January* 1841.

XII.—*Proceedings of the Madras Literary Society and Auxiliary of the Royal Asiatic Society.*

Thursday Evening, 6th August 1840.—A. D. Campbell, Esq. *President of the Committee of Papers, in the Chair.*

The following works, presented to the Society, were laid on the table, and thanks voted to the donors:—

Transactions of the Geological Society of London, Second Series, parts 1st and 2d of vol. 5th.—By the Society.

Journal of the Asiatic Society of Bengal for December 1839 and January 1840.—By the Society.

The Calcutta Journal of Natural History, No. 2.—By the Editor.

Dr. Corbyn's India Review, No. 50.—By the Editor.

Journal Asiatique for January 1840.—By the Society.

Asiatic Journal for March and April 1840.--By the Editor.

The following communications to the Society were laid before the Meeting:—

A notice, accompanied with a diagram, of the rocks passed over during a march from Secunderabad to Ahmednuggur in the Dekkan.—By Assist. Surgeon Balfour, 4th Battalion Madras Artillery.

An attempt to enumerate and form a Diagram of the Rocks near the Cantonment of Secunderabad—drawn up in 1838—By the same.

Some particulars respecting the statue of Sir Thomas Munro—By C.

On the basaltic granite of the Barramahal and the Basalt dykes of India, with a sketch—By Captain Campbell, Assistant Surveyor General.

Note on the Chenchu Wandlu or wild people of the Nulla Mulla hills. —By Lieutenant Newbold.

Note on the defaced state in which the statues of the Jains are now generally found, as connected with their persecutions and overthrow.—By the same.

Note on an ancient Hindu Grant—By Walter Elliot, Esq.

The following letter from the Right Honourable the Earl of Munster was read.

Sir,—I beg to apologize for addressing you, but, my object in so doing being of an interesting literary nature, I trust that you will not only forgive my thus intruding on your valuable time, but that you will (as *much depends* on your *co-operation*), kindly, and warmly, enter into my views.

I have been for many years employed in collecting materials for a Military History of the Mahomedan nations, from the rise of their founder till the present time, and have already made great progress in all details relative to the different people, who have embraced that religion, whether of Arabian or Tartar origin.

I have lately drawn up, in Arabic, a list of military and historical books, which I am desirous to procure, and have accompanied it with a military notice, of some length, in order to point out the subject of the works, which would be most adapted to my researches.

Perhaps you may be so situated, as to assist me in its dissemination, and although I am fully aware of the difficulty that surrounds an at-

tempt of this nature in some Mahomedan cities, yet I hope you may have formed an acquaintance with some Sheick or learned man, who might be persuaded to aid in searching for, and purchasing for me, the books I require.

Should such a person exist, I shall be grateful if you will, with whatever precaution or secresy that may be deemed necessary, put the accompanying Memoir into his hand, and invite him to meet my wishes, by procuring for me the class of historical and military works, named or indicated in it, not only in Arabic, but in Turkish, Chagataï or Tartar, in Persian, Hindostanee, and in all the indigenous languages of India.

But, not only do I look for books, but I should be greatly pleased and aided, by any learned and intelligent Mahomedan gentleman or officer (some of the latter of Western Asia having been of late years educated in Europe) referring to my military memoir, and answering my questions, one by one, and if he would give me in writing the information I desire, including all military technical synonimous terms, of the present as well as of past times.

It is possible, in Egypt, Western Asia and Persia, and still more likely in India, that some European gentlemen from long residence in those countries, may be equal to answering the various *items* of my Memoir. I have reason to believe, that there are several intelligent European Officers in the armies of the Osmanli, of Mahomet Aly Pascha and of Persia—thus situated—while in India, many Civilians and Officers of the India Company's Service, I know to be highly qualified to give me the aid I solicit, and who might, from advantages of vicinity and other circumstances, enter fully upon the Mahomedan art of war in India, of all past centuries, to the present time.

If any gentleman in India, would thus enter into my views, I would particularly point out (besides the past art of war of Persian and Tartar origin and the collection of the past and existing military terms and expressions, of the present native camps and armies) the ancient indigenous Hindoo mode of warfare, previous to, and wholly unconnected with, that introduced by their northern conqueror, and to the military terms (not forgetting the modern) either in the Sanscrit, or as preserved in its cognate existing languages.

I need hardly say, that I shall not be backward in acknowledging, both privately and publicly any such assistance.

I have limited the notices in my Memoir, to the end of the temporal power of the Eastern Khalifs (334 H.); considering the details I have

brought forward, sufficient to be a guide for similar researches in after periods and dynasties, and which I wish to be equally illustrated, whether of the Ommiades of Spain, of the Fatimites of Egypt, of the minor kingdoms of the West of Asia on the decline of the court of Bagdad, of the Siljuks, of the Moguls of Ghinges Khan, of Persia, and, of farther East—of the Ghisnivides, Gearides of the Pitan Kanes, and of the family of Timour, at Delhi, and of the numerous sovereignties both of Hindostan and of the Dekkun.

I have reason to believe that the price of books (whatever it may be in Persia, India, or Cabul) in Western Asia, is far from exorbitant, having just received two volumes from Egypt of considerable intrinsic value, for which I only paid 123 Piastres or 23 shillings, and would not wish you (as I am making similar purchases throughout the Mahomedan world) to give, on ordinary occasions, above one pound or 30 to 100 Piastres, for a single volume.

But as some peculiarly scarce, interesting and valuable works, may be offered, I shall beg of you to use your own discretion, as to their prices and immediate purchase, or in first letting me know, what is asked for them or in that of the alternative of having them, if possible, copied.

You may rest assured, I shall be perfectly satisfied with your decision, and shall be grateful, (should you be inclined to meet my wishes) if you will, as soon as you have ascertained that the books selected are pertinent to my objects, to pay for them, and I will instantly on receiving your letter, transfer the amount to your Bankers in London, including any expence on their transmission to 13 Belgrave Street, London—the mode of which, I must leave to your friendly arrangement.

I have the honour to be,

Sir,

Your obedient Servant.

(Signed) Munster.

Lord Munster's communication is referred to the Committee of Papers, who are requested to further by all means in their power the wishes of his Lordship.

Read the following letter from the same Nobleman, accompanying his *Index* of books desired.

Sir,—I trust the Literary Society of Madras will kindly accept the accompanying Memoir, rather as a literary curiosity than for any actual merit it possesses, but I trust the subject and object—for which I

have drawn it up, will attract the notice of some of the Society's Members and cause them to aid my views and wishes.

Trusting I shall hear from you to that effect,

I have the honour to be,

Sir,

Your obedient Servant.

(Signed) MUNSTER.

PARIS, 3d May 1840.

Resolved, that every assistance in the Society's power be afforded to his Lordship.

Read a letter from Lieutenant J. Whitlock, 8th Cavalry, forwarding a spherical sandstone concretion, from the red marle cliffs of Dawlish in Devonshire, which he supposes to be of the same character as those described in the proceedings of the Society's Meeting of the 13th of February last, as having been found in the laterite formation at Streepermadoor:— offering, also, to procure for the Society specimens of the Alcyonites found at Gurrah, near Nagpore.

The thanks of the Society were voted to Lieutenant Whitlock for his donation, and an assurance that the promised fossils will be thankfully received.

Read extract from a letter from Lieutenant T. J. Newbold, dated Suez, 31st May 1840, forwarding for the Society's Museum minerals from the shores of the Red Sea.

The thanks of the Society were voted for the same.

Read a letter from the Secretary to the Geological Society expressing thanks for the donation of the Society's Journal No. 23.

Thursday Evening, 3d September 1840—*Captain* J. T. SMITH, *in the Chair.*

The following works, presented to the Society, were laid on the table, and thanks voted for the same:—

Transactions of the Agricultural and Horticultural Society of India—vol. 7th—By the Society.

Journal of the Asiatic Society of Bengal, Nos. 13 and 14—By the Society.

Corbyn's India Review and Journal of Foreign Science and the Arts, No. 53, August 1840—By the Editor.

Topography of Calcutta—By Dr. Strong, presented, on the part of the author, by D. Ross, Esq.

The following communications to the Society, were laid before the Meeting:—

Continuation of the Catalogue of the birds of Southern India, by T. C. Jerdon, Esq.—Tribe Conirostres.

Mr. Elliot's notice of some Roman coins found near Sholapoor.

Horary Meteorological Observations made agreeably with the suggestions of Sir John Herschel.

1*st.—At the Madras Observatory on the* 21*st June* 1840.

1840.	Time.	Barometer.	Thermometer. Dry.	Thermometer. Wet.	Direction of wind.	Strength of wind.	Remarks.
June 21	6 A. M.	29,816	86,5	12,0	s w	2	Thick haze—strong wind.
	7	840	86,9	11,9	w	2,3	Haze do. do.
	8	850	87,9	12,5	w	3	Do. do. do.
	9	862	90,0	14,0	w	3	Do. do. do.
	10	860	91,0	14,8	w	3,4	Do. do. do.
	11	843	92,9	16,3	s w	4	Fl. clouds do. do.
	12	824	95,7	18,7	w	3	Do. do. do.
	1 P.M.	818	97,7	20,2	w	3	Do. do. do.
	2	792	98,7	21,0	w	3	Do. do. do.
	3	770	99,7	22,1	w	4	Do. do. do.
	4	756	99,8	22,4	w by N	3	Cloudy.
	5	758	98,2	21,4	sw by w	2,3	Do.
	6	764	98,0	21,5	s s w	2	Do.
	7	790	96,4	19,4	s w	1	Do. gentle wind—lightn.
	8	800	89,8	7,9	s w	1	Do. do. do. do.
	9	810	93,8	17,3	s w	2,3	Do. strong wind—thr. & lt.
	10	848	94,3	18,8	w	2,3	Do. do. lightning
	11	846	93,0	17,6	w	2,3	Do. do. do.
	12	832	92,0	16,0	w	2,3	Thick haze, strong wind, ltn.
	1 A.M.	804	89,0	14,0	w	3	Do. do. do. do.
	2	786	87,5	12,4	w	3,4	Do. do. do. do.
	3	778	87,0	12,1	s w	3	Do. do. do. do.
	4	772	86,2	11,2	sw by w	3	Do. do. do. do.
	5	790	85,9	10,9	sw by w	3	Do. do. do. do.
22	6	800	85,4	10,5	sw by w	3	Do. do. do. do.
	7	806	86,4	11,2	sw by w	2,3	Do. do. do. do.
	8	810	88,4	13,2	sw by w	3,4	Haze—strong wind.
	9	816	90,3	14,3	w	4	Haze—very strong wind.
	10	820	92,3	15,4	w	4	Fl. cl.—very strong wind.
	11	808	92,8	16,3	w	4,5	Fl. cl. do. do. do.
	12	774	95,7	18,3	w	4	Fl. cl. do. do. do.
	1 P.M.	750	97,7	20,2	w	4	Fl. cl. do. do. do.
	2	726	98,9	21,9	w	4	Thick hz.—very strong wind.
	3	734	100,5	23,5	w	3	Cloudy—strong wind.
	4	682	100,3	23,5	w N w	2,3	Cloudy.
	5	678	100,0	23,3	w by s	3	Cloudy.
	6	702	98,2	21,9	w s w	2	Cloudy.

2*d.—At the Trevandrum Observatory at the Autumnal Equinox* 1840.

Date.	Hour.	Newman's Standard bar. corrected for temp. 32° and for capillarity.	Standard thermometer.	Depress. of wet bulb. thermometer.	Dew point.	Direction of wind.	Velocity of the wind.	Solar radiation.	Clouds, aspect of the sky and remarks.
Sept. 21	6 A.M.	29.671	73.8	2.4	70.27	N. W by W.	3		Sky rather clear cold wind.
	7	.697	75.2	2.6	71.43	do.	3	2.5	Do. do.
	8	.714	77.0	3.6	71.82	do.	5	3.0	Do. gentle wind.
	9	.715	79.5	4.9	72.52	do.	5	5.5	Flying clouds. do.
	10	.715	81.5	6.4	72.40	do.	5	4.5	Do. do.
	11	.687	84.0	7.9	72.85	do.	5	Cly.	Do. do.
	Noon.	.664	85.0	7.9	73.97	do.	5	7.0	Do. do.
	1 P.M.	.641	85.6	9.0	72.95	W.	3	2.5	Do. cumuli about hor. do. increasing.
	2	.615	85.0	9.2	71.94	do.	6	8.0	Do. do. pleasant wind.
	3	.609	84.7	9.1	71.75	do.	3	3.0	Do. do. gentle wind.
	4	.606	83.9	8.1	72.43	do.	4	3.3	Do. do. do.
	5	.628	81.8	6.0	73.34	do.	4		Sky cloudy do.
	6	.643	79.9	5.4	72·19	do.	2		Sky getting clear light air.
	7	.668	78.8	4.3	72.68	W. by N.	2		Sky pretty clear do.
	8	.697	78.2	4.4	71.88	do.	1	No observation.	Do. do.
	9	.715	77.7	4.2	71.65	do.	1		Do. do.
	10	.726	77.2	3.7	71.88	do.	,,		Sky getting cloudy calm.
	11	.709	76.4	3.1	71.94	do.	,,		Cloudy do.
	Mid.	.707	76.0	2.7	72.12	do.	,,		Do. do.
,, 22	1 A.M.	.681	75.6	2.1	72.59	W.	2		Do. at 1h. 10m. rain—wind just perceptible.
	2	.652	75.4	1.6	73.12	do.	,,		Zenith clear nearly calm.
	3	.649	75.2	1.5	73.06	do.	,,		Sky rather cloudy. do.
	4	.647	75.0	1.7	72.56	do.	,,		Do. do.
	5	.651	74.3	1.7	71.84	do.	,,		Do. do.
	6	.672	74.5	1.6	72.19	N.W by W.	2		Do. light air.
	7	.687	75.9	1.5	73.78	W. N. W.	2	0.5	Do. do.
	8	.630	77.2	2.4	73.81	N. W by N.	5	1.8	Do. gentle wind.
	9	.701	79.2	3.1	74.87	W. by N.	4	4.3	Flying clouds do.
	10	.688	81.0	4.7	74.43	W.	3	Cly	Cloudy do.
	11	.665	82.2	5.5	74.53	do.	6	9.0	Thick cumuli rising; pleasant do.
	Noon.	.642	84.6	7.1	74.73	do.	3	8.8	Sky getting clear gentle do.
	1 P.M.	.609	85.5	8.1	74.21	do.	4	11.0	Do. do.
	2	.587	85.0	7.9	73.97	do.	4	9.5	Do. do.
	3	.570	85.5	8.4	73.76	do.	4	3.5	Cirrus in the zenith; cumuli about the hor. gentle wind.
	4	.567	85.0	9.6	71.29	do,	3	4.5	Clear do.
	5	.582	82.0	7.7	70.91	do.	3	2.5	Very clear do.
	6	29.606	79.8	5.1	72.54	do.	3		Do. do.

September 21st rain fell from 6 A. M. to 6 P. M. None.
do. 6 P. M. to 6 A. M. ·0421.
September 22d do. 6 A. M. to 6 P. M. None.

Total. ·0421

The Instruments are the same, and situated exactly as before.

G. SPERSCHNEIDER, *Superintendent.*

METEOROLOGICAL REGISTER KEPT AT THE MADRAS OBSERVATORY; FOR THE MONTH OF APRIL, 1840.

Days.	Barometer at 10 A. M.	Barometer at 4 P. M.	Barometer at 10 P. M.	Ther. at 10 A. M.	Ther. at 4 P. M.	Ther. at 10 P. M.	Wet Bulb. 10 A. M.	Wet Bulb. 4 P. M.	Wet Bulb. 10 P. M.	Rain. Sun-rise.	Rain. Sun-set.	Evaporation.	Strength of wind.	Direction of Wind. 10 A. M.	Direction of Wind. 4 P. M.	Direction of Wind. 10 P. M.	Cloudy Max.	Weather. 10 P. M.	Weather. 4 P. M.	10 P. M.	Remarks.
1840	Inch.	Inch.	Inch.	o	o	o	o	o	o												
Apr. 1	30,114	30,003	30,082	83,5	85,6	83,0	5,3	8,2	5,0	......	......	2,478	2,3	E	S E	S E	1	Clear.	Clear	Clear	dew.
2	,150	,010	,082	83,7	86,0	82,8	6,2	7,0	4,3	......	......	......	2,3	S E	S. S E	S	1	Fl. cl.	Clear	Clear	do.
3	,102	29,945	,022	84,0	87,0	83,6	5,7	8,0	5,2	......	......	......	2,3	S	S E	S	1	Clear	Clear	Clear	do.
4	.038	,948	,016	84,5	86,0	83,1	6,4	6,2	3,2	......	......	......	2,3	S	S E	S E	3	Clear	Clear	Fl. cl.—lightning.	do.
5	29,998	——	29,992	86,0	—	84,0	6,5	—	2,5	......	......	......	2,3	S W	——	S E	3	Clear	——	Haze do.	——
6	30,022	29,916	30,000	86,0	87,0	84,0	6,5	7,0	4,0	......	......	......	2,3	S	S by E	S	2	Fl. cl.	Clear	Clear do.	——
7	,034	,900	29,982	85,6	87,4	84,2	5,6	6,7	3,2	......	......	......	2,3	S W	S E	S	3	Fl. cl.	Clear	Fl. cl. do.	——
8	,002	,897	,972	85,6	87,6	84,0	7,2	7,8	4,5	......	......	2,833	3	S W	S E	S E	2	Fl. cl.	Clear	Clear do.	——
9	,014	,903	,968	86,0	86,2	83,9	6,6	6,2	4,0	......	......	......	3	S	S. S E	S E	2	Clear	Clear	Clear do.	——
10	,020	,900	,974	85,7	87,0	84,0	6,2	8,4	4,0	......	......	......	2,3	S	S	S	2	Fl. cl.	Clear	Clear do.	——
11	,000	,882	,956	85,5	87,0	83,8	7,7	7.0	3,3	......	......	......	2,3	S	S. S E	S E	1	Fl. cl.	Clear	Clear do.	——
12	,000	——	,992	86,0	—	85,5	2,5	—	4,1	......	......	......	2,3	S	——	S E	1	Fl. cl.	——	Clear ——	——
13	,016	,907	30.000	86,5	88,3	84,5	7,0	—	3,5	......	......	......	2,3	S	S E	S	1	Fl. cl.	Clear	Clear ——	——
14	,012	,888	29,978	86,8	88,0	85,0	8,4	6,7	4,0	......	......	......	2,3	S W	S E	S	1	Clear	Clear	Clear—lightning	——
15	29,962	,858	,920	86,8	87,0	84,4	7,3	5,5	2,9	......	......	......	2,3	S W	S E	S	1	Clear	Clear	Clear ——	
16	,962	,838	,922	87,5	89,0	85,2	8,0	8,3	3,3	......	......	......	2,3	S W	S E	S	2	Clear	Clear	Fl. cl. ——	
17	,966	,870	,958	86,6	87,0	83,9	4,6	5,5	3,6	......	......	......	2,3	S. S E	S E	——	2	Clear	Clear	Haze ——	
18	30,018	——	30,044	85.3	—	85,9	5,9	—	4,6	......	......	......	2,3	S	——	——	2	Clear	——	Clear ——	
19	——	——	,000	—	—	85,9	—	—	4,2	......	......	......	2,3	——	——	S E	1	——	——	Clear ——	
20	——	——	29,926	—	—	84,3	—	—	3,4	......	......	......	2,3	——	——	S	1	——	——	Clear ——	
21	29,943	29,783	,842	86,5	86,4	84.0	8,1	5,0	3,5	......	......	3,011	3	S W	S E	S E	2	Clear	Clear	Haze—lightning.	
22	,842	,770	,864	88,5	86,3	85,9	9,0	5,5	4,5	......	......		2,3	S W	S E	S E	2,3	Haze	Haze	Haze do.	
23	,914	,800	,862	87,7	88,0	84,2	7,7	7,3	3,8	......	......		2,3	S E	S E	S E	2	Fl. cl.	Clear	Clear do.	
24	.898	,755	,848	87,8	88,2	85,7	8.4	6,7	3,7	......	......		2,3	S W	S E	S E	2	Fl. cl.	Th. hz.	Haze ——	
25	,838	.710	,790	89,8	88,0	85,9	0,9	6,3	2,1	......	......		2,3	S W	S E	S W	2	Clear	Clear	Haze—lightning	
26	,770	——	,766	89,8	—	87,3	10,8	—	4,8	......	......		2,3	S W	——	S	2,3	Haze	——	Fl. cl. land-wind th. and lightn.	
27	,734	,614	,706	91,8	91,0	89,7	2,3	6,5	6,7	......	......		2,3	W	S E	S. S W	4	Clear	Haze	Haze th. and vivid lightning.	
28	,728	,628	,720	93,0	90,0	88,4	5,3	—	6,4	0,025	......		2,3	N. N W	S E	Calm	3	Clear	Clear	Thick haze; lightning.	
29	,698	,605	,684	90,7	91,3	89,2	8,9	9,8	4,7	......	......	3,280	2,3	N. N W	S E	S	4	Haze	Haze	Haze lightning.	
30	,696	,568	,680	90,1	99,0	89,8	9,3	9,4	5,4	......	......		2,3	W	S E	S	3	Haze	Th. hz.	Haze—vivid lightning.	
Mean	29,946	29,829	29,918	87,0	88,1	85,2	6,6	7,0	4,1												

METEOROLOGICAL REGISTER KEPT AT THE MADRAS OBSERVATORY; FOR THE MONTH OF MAY, 1840.

Days.	Barometer at 10 A. M.	Barometer at 4 P. M.	Barometer at 10 P. M.	Ther. at 10 A. M.	Ther. at 4 P. M.	Ther. at 10 P. M.	Wet Bulb. 10 A. M.	Wet Bulb. 4 P. M.	Wet Bulb. 10 P. M.	Rain. Sun-rise.	Rain. Sun-set.	Evaporation.	Strength of wind.	Direction of Wind. 10 A. M.	Direction of Wind. 4 P. M.	Direction of Wind. 4 P. M.	Cloudy Max.	Weather. 10 A. M.	Weather. 4 P. M.	Remarks. 10 P. M.
1840	Inch.	Inch.	Inch.	o	o	o	o	o	o											
May 1	29,744	29,643	29,798	91,8	93,0	86,5	8,3	11,7	6,1	......	......	......	2,3	w	s	s. se	2	Haze	Haze	Haze—lightning.
2	,856	,750	,858	89,8	89,0	87,8	11,8	6,8	6,4	......	......	......	2,3	w	s	s	3	Clear	Cloudy	Fl. cl. do.
3	,888	——	,822	88,6	—	90,3	9,2	—	7,3	......	......	......	2,3	s w	——	s	3	Clear	Cloudy	Fl. cl. do. and thunder.
4	,854	,714	,800	91,5	94,0	88,2	12,5	13,6	6,2	......	......	......	2,3	s w	s e	s. s w	3	Clear	Cloudy	Fl. cl. do. do.
5	,864	,743	,812	92,0	93,0	88,2	12,4	13,3	6,7	......	......	......	2,3	s w	s e	s. s w	3	Clear	Cloudy	Clear do. do.
6	,890	,800	,876	90,9	90,7	86,4	11,5	8,2	3,8	......	......	3,492	2,3	swbyw	s w	s	3	Clear	Cloudy	Th. hz. thunder in the evening.
7	,900	,790	,860	91,0	92,0	89,2	12,1	10,0	6,7	......	......	......	2,3	s w	s w	s w	3	Cloudy	Cloudy	Clear, thunder, lightning and drizzling rain at 5 P. M.
8	,872	,770	,834	92,5	93,0	91,0	16,0	10,3	8,0	......	......	......	2,3	w	s w	s	3	Clear	Cloudy	Fl. cl. thunder at 4 P. M.
9	,866	,766	,834	89,7	89,7	89,4	9,2	12,4	19,3	......	......	......	2,3	w	n w	w	4	Fl. cl.	Cloudy	Th. hz. do. lightning and drizzling rain at 4. P. M.
10	,876	——	,866	89,5	—	89,0	9,2	—	5,4	......	......	......	2,3	w	——	s	3	Clear	——	Th. hz. lightning.
11	,896	,782	,890	89,3	89,6	86,6	11,8	8,9	3,2	......	......	......	2	swbyw	s w	s w	2	Haze	Th. hz.	Clear do.
12	,916	,810	,902	88,4	89,8	88,6	9,2	7,8	4,9	......	......	......	2,3	s w	s w	s	2	Haze	Th. hz.	Haze do. th. hz. at night.
13	,938	,808	,916	88,6	89,0	86,7	10,0	7,6	4,2	......	......	3,808	2,3	s w	s w	s	2	Clear	Th. hz.	Clear do. th. hz. at night.
14	,916	,810	,908	90,3	90,0	87,4	11,4	9,3	5,4	......	......	......	2,3	s	s	s	2	Clear	Haze	Haze ——
15	,927	,796	,862	91,0	92,0	86,3	13,5	12,0	5,9	......	......	......	3	s w	s	s. s w	0	Clear	Haze	Clear ——
16	,892	,766	,830	92,4	91,6	86,6	13,4	11,8	6,6	......	......	......	2,3	swbyw	s. s w	s. s e	2	Clear	Clear	Clear lt. strong wind at night.
17	,814	——	,854	93,0	—	91,0	12,0	—	12,4	......	......	......	2,3	w n w	——	s	3	Clear	——	Fl. cl. loud th. and vivid lightn.
18	,928	,796	,876	82,8	89,7	85,9	5,3	8,2	5,9	......	......	......	2,3	nwbyw	s w	s	3	Cloudy	Clear	Haze lightning.
19	,888	,778	,836	88,2	91,3	87,2	8,2	10,3	5,2	......	......	......	3	w	s w	s w	2	Clear	Clear	Clear do. strong wind at night.
20	,842	,735	,810	90,6	91,8	87,0	11,7	11,0	7,0	......	......	3,093	3	s w	s w	s	2	Clear	Clear	Clear do. do. do.
21	,828	,730	,830	90,9	90,8	89,2	13,9	10,0	6,1	......	......	......	4	s w	s w	s	4	Clear	Cloudy	Cloudy do. do. do. and drizzling rain in the morning.
22	,862	,743	,831	91,2	92,0	89,5	11,2	10,0	7,8	......	......	......	3	s w	s w	s w	3	Haze	Cloudy	Th. hz. thunder and lightning.
23	,848	,737	,818	91,8	92,7	87,7	15,9	11,7	7,7	......	......	......	3	s w	s w	s. s w	4	Clear	Clear	Clear lightning.
24	,850	,738	,852	91,0	90,0	89,0	11,5	7,5	7,0	......	......	......	3	s w	s w	s w	2	Clear	Clear	Clear do.
25	,898	,764	,856	90,8	92,0	88,3	12,8	8,0	6,8	......	......	......	2	w	s w	s e	2	Clear	Clear	Clear do.
26	,886	,774	,838	90,3	91,8	90,5	10,8	10,3	9.0	......	......	......	2	w	s w	s w	2	Clear	Clear	Cloudy do.
27	,862	,770	,840	91,7	93,3	90,3	13,7	10,0	9,9	......	......	4,255	3	s. s w	s w	s. s w	3	Clear	Cloudy	Cloudy do.
28	,822	,728	,836	91,7	90,0	89,8	13,9	11,2	6,4	......	......	......	3	s w	s w	s	4	Haze	Cloudy	Cloudy vivid do.
29	,832	,730	,808	90,0	90,3	87,8	7,0	6,0	5,8	......	......	......	2,3	s. s e	s e	s	1	Clear	Clear	Clear lightning. [and night.
30	,846	,720	,814	89,9	90,0	85,9	11,9	7,2	2,9	......	......	......	2,3	s w	s e	s	1	Clear	Clear	Clear do. strong wind at day
31	,828	——	,818	89,3	—	88,0	6,3	—	5,0	......	......	......		s. s e	——	s	3			—— do.
Mean	29,869	29,759	29,815	90,3	91,2	88,2	11,2	9,9	6,8											

METEOROLOGICAL REGISTER KEPT AT THE MADRAS OBSERVATORY; FOR THE MONTH OF JUNE, 1840.

Days.	Barometer at 10 A. M.	Barometer at 4 P. M.	Barometer at 10 P. M.	Ther. at 10 A. M.	Ther. at 4 P. M.	Ther. at 10 P. M.	Wet Bulb. 10 A. M.	Wet Bulb. 4 P. M.	Wet Bulb. 10 P. M.	Rain. Sun-rise,	Rain. Sun-set.	Evaporation.	Strength of wind.	Direction of Wind. 10 A. M.	Direction of Wind. 4 P. M.	Direction of Wind. 10 P. M.	Cloudy Max.	Weather. 10 A. M.	Weather. 4 P. M.	Remarks. 10 P. M.
1840	Inch.	Inch.	Inch.	o	o	o	o	o	o											
June 1	29,798	29,712	29,786	89,8	89,2	86,7	12,8	7,7	6.7	......	......	......	2,3	S	S E	S W	4	Haze	Cloudy	Fl. cl. lightning.
2	,812	,710	,790	88,5	90,3	86,2	8,0	6,3	2,7	......	......	......	,2	S	S E	S E	2	Fl. cl.	Haze	Clear do.
3	,842	,742	,850	88,7	88,3	87,9	5,7	7,3	4,2	......	......	3,346	,2	S.SE	S E	S E	2	Fl. cl.	Th. hz.	Th. haze do.
4	,864	,760	,850	88,7	90,0	86,8	7,7	8,0	4,4	......	......	......	,2	E	S E	S E	1	Clear	Clear	Cloudy do.
5	,824	,722	,814	88,2	89,0	86,3	6,2	8,0	4,3	......	......	......	,2	S.SE	S E	S E	1	Haze	Clear	Clear—vivid do.
6	,800	,713	,826	87,9	88,3	86,3	5,8	6,9	4,8	......	......	......	,2	E	S E	S E	2	Fl. cl.	Clear	Fl. cl. do.
7	,808	——	,822	88,5	——	87,5	6,5	—	4,1	......	......	......	,2		——	S E	4	Clear	——	Fl. cl. thunder and lightning.
8	,818	,720	,802	87,8	90,0	87,0	7,3	9,3	4,5	0,077	......	......	,2	S W	S E	S E	2	Fl. cl.	Clear	Fl. cl. do.
9	,778	,673	,748	90,9	91,2	89,7	4,9	8,2	8,7	......	......	......	,2	W	S E	S	4	Haze	Cloudy	Haze and flying cl. vivid do.
10	,752	,650	,766	90,0	84,0	89,2	11,5	3,3	9,8	......	......	2,985	,2	W	S E	S	3	Haze	Cloudy	Fl. cl. thunder in the evening lightning at night.
11	,862	,640	,750	90,8	90,0	88,7	12,3	6,8	4,1	......	......	......	,2	N W	E by S	S	2,3	Haze	Cloudy	Cloudy lightning.
12	,752	,658	,750	84.3	89,0	83,5	5,9	—	4,5	......	......	......	,2	S W	S SW	S W	8	Cloudy	Cloudy	Cloudy do.
13	,732	,668	,704	83,9	84,0	84,2	5,9	5,2	5.7	0,155	......	......	,2	W	N W	W	9	Cloudy	Cloudy	Cloudy do.
14	,726	——	,700	86,0	——	85,9	8,3	—	8,4	......	......	......	,2	W	——	S W	9	Cloudy	——	Cloudy do.
15	,722	,630	,764	88,2	93,2	87,2	12,3	16,2	7,8	......	......	......	,3	W	S W	S W	8	Th. hz.	Cloudy	Cloudy do.
16	,766	,700	,800	90,2	92,8	89,8	3,3	15,8	5,8	......	......	......	,3	S W	S E	S	7	Haze	Cloudy	Haze do.
17	,826	,730	,816	90,8	93,3	90,6	12,9	14,3	7,7	......	......	3,013	2,3	S W	SE by S	S	7	Haze	Cloudy	Haze do.
18	,820	,700	,780	89,0	95,3	91,9	13,1	18,3	9,5	......	......	......	2,3	W	W.SW	S	6	Haze	Cloudy	Fl. cl. do.
19	,798	,683	,756	91,0	94,5	91,9	14,1	17,7	9,1	......	......	......	2,3	SWbyW	S W	S	5	Haze	Cloudy	Haze do.
20	,826	,714	,804	91,6	97,8	92,0	14,6	20,3	9,0	......	......	......	,3	SWbyW	W by N	S	7	Haze	Cloudy	Fl. cl. do.
21	,860	,756	,848	91,0	99,8	94,3	14,8	22,4	18,8	......	......	......	,3	W	do.	W	7	Haze	Cloudy	Cloudy thunder and do. strong wind at day and night.
22	,820	,682	,770	92,3	100,3	94,4	15,4	23.5	16,2	......	......	......	,3	W	W.NW	S W	5	Fl. cl.	Cloudy	Haze do. do. do. do.
23	,776	,660	,768	91,8	100.0	95,5	15,8	23,0	18,5	......	......	......	,3	W	W by S	W	5	Haze	Cloudy	Fl. cl. do. do. do. do.
24	,802	,710	,834	92,9	96,8	92,5	16,9	18,8	10,9	......	0,032	5,339	2,3	W	E	S W	6	Clear	Cloudy	Cloudy do.
25	,852	,758	,852	91,7	93,0	90,0	15,6	13,0	7,0	......	......	......	2,3	SWbyW	E. SE	S	6	Haze	Fl. cl.	Cloudy do.
26	,888	,780	,854	91,7	92,3	86,6	15,8	9,0	2,1	......	0,217	......	2,3	W.NW	E. SE	S	5	Haze	Cloudy	Fl. cl. do.
27	,868	,764	,854	90,8	92,0	89,5	12,2	11,5	7,1	......	......	......	2,3	N W	E. SE	S	5	Clear	Fl. cl.	Fl. cl.—rainbow to the west thunder and lightning.
28	,850	——	,842	89,0	——	89,7	11,1	—	7,3	......	......	......	2,3	W	——	S	6	Clear	Fl. cl.	Cloudy—lightning.
29	,840	,760	,840	91,0	85,8	87,9	12,7	7,8	8.0	......	......	......	2,3	S W	N	S E	5	Fl. cl.	Cloudy	Fl. cl. thunder in the afternoon
30	,858	,810	,854	89,8	89,0	85,9	11,3	9,5	8,4	......	......	......	,2	N W	W.NW	S W	4	Fl. cl.	Cloudy	Haze—lightning.
Mean	29,811	29,711	29,800	89,6	91,8	88.9	10.7	12,2	7,7											

The instruments with which the foregoing observations are made, are placed in the Western Verandah of the Honourable Company's Observatory; at about five feet above the surface of the ground, and twenty-seven feet above the level of the Sea: the thermometer was made on purpose for the Observatory, and at 75° (the only point at which a comparison has been made) it was found to differ insensibly from the Royal Society's Standard; the barometer is one of two Standards which have been lately constructed, and may be depended upon to 0,0100 an inch.

J. Crisp, Major.
H. C. Acting Astronomer.